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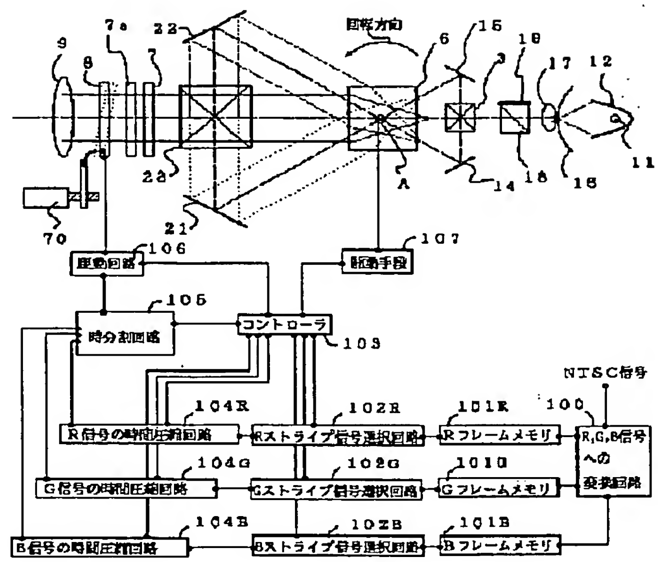
TITLE : LIQUID CRYSTAL PROJECTOR



ABSTRACT : PURPOSE: To provide a liquid crystal projector which is specified in the beginning point position of perpendicular scanning of the RGB striped luminous fluxes of a liquid crystal panel, is nearly specified in intervals and has the high linearity of a moving speed for irradiation.

CONSTITUTION: This liquid crystal projector has a light source 11, a reflector 12 for reflecting and condensing the light from this light source 11, a means for separating the condensed luminous fluxes to the luminous fluxes of three colors; red, green and blue, the liquid crystal panel 8, and a columnar body having a regular polygonal section having opposite parallel planes axisymmetrical with the axis of rotation. In addition, the projector has a rotary prism 6 which scans the surface of the liquid crystal panel with the stripes of three colors by receiving the luminous fluxes of the three colors on its side face and irradiates the surface of the liquid crystal panel with luminous fluxes to a stripe form these. One of the luminous fluxes of the three colors is used as a main optical axis and this main optical axis is intersected orthogonally with the axis A of rotation. The liquid crystal projector has a pair of incident means 14, 15 which incline the remaining two of the luminous fluxes of the three colors as auxiliary optical axes symetrically with the main optical axis and intersect these auxiliary optical axes with the intersected point of the main optical axis and the axis A of rotation and assembling means 21 to 23 which arrange the auxiliary optical axes parallel with the main optical axis.

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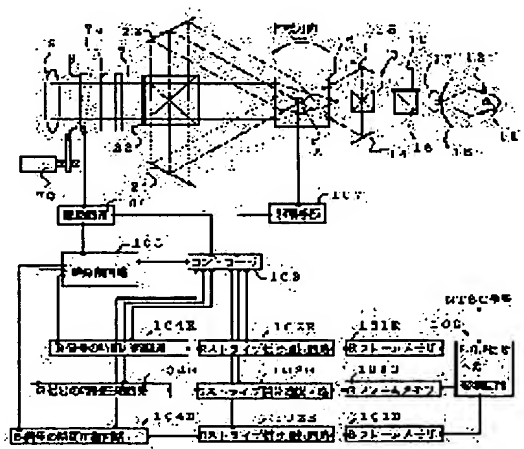
(54) LIQUID CRYSTAL PROJECTOR

(57)Abstract:
PURPOSE: To provide a liquid crystal projector which is specified in the beginning point position of perpendicular scanning of the RGB striped luminous fluxes of a liquid crystal panel, is nearly specified in intervals and has the high linearity of a moving speed for irradiation.
CONSTITUTION: This liquid crystal projector has a light source 11, a reflector 12 for reflecting and condensing the light from this light source 11, a means for separating the condensed luminous fluxes to the luminous fluxes of three colors; red, green and blue, the liquid crystal panel 8, and a columnar body having a regular polygonal section having opposite parallel planes axisymmetrical with the axis of rotation. In addition, the projector has a rotary prism 6 which scans the surface of the liquid crystal panel with the stripes of three colors by receiving the luminous fluxes of the three colors on its side face and irradiates the surface of the liquid crystal panel with luminous fluxes to a stripe form these. One of the luminous fluxes of the three colors is used as a main optical axis and this main optical axis is intersected orthogonally with the axis A of rotation. The liquid crystal projector has a pair of incident means 14, 15 which incline the remaining two of the luminous fluxes of the three colors as auxiliary optical axes symetrically with the main optical axis and intersect these auxiliary optical axes with the intersected point of the main optical axis and the axis A of rotation and assembling means 21 to 23 which arrange the auxiliary optical axes parallel with the main optical axis.



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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The light source, the reflector which reflects the light from the light source and is made to condense, and the condensed flux of light Red and an optical separation means to separate into the flux of light of green and three blue colors, Become a liquid crystal panel and a revolving shaft from the pillar-shaped object of the regular-polygon cross section which has an opposite parallel side by axial symmetry, and receive the flux of light of said three colors in the side face, and these are irradiated in the shape of a stripe on said liquid crystal panel. Are the liquid crystal projector to which it has the rotating prism which scans the stripe of three colors on said liquid crystal panel, and said revolving shaft and this main optical axis cross at right angles by using one of the flux of lights of said three colors as the main optical axis, and two in which the flux of light of said three colors remains are used as a suboptical axis. The liquid crystal projector characterized by having the incidence means which the symmetry is made to incline to said main optical axis, and carries out incidence of this suboptical axis at the intersection of said main optical axis and said revolving shaft, and a set means to gather said suboptical axis to said main optical axis at parallel.
[Claim 2] Said rotating prism is a liquid crystal projector according to claim 1 characterized by being the pillar-shaped object of a square cross section.
[Claim 3] Said suboptical axis is a liquid crystal projector according to claim 1 characterized by inclining in the symmetry to said main optical axis in [include-angle] 0< theta<=30 degrees, respectively.
[Claim 4] Said suboptical axis is a liquid crystal projector according to claim 3 characterized by inclining in the symmetry to said main optical axis at the include angle of 30 degrees, respectively.
[Claim 5] Said reflector is a liquid crystal projector according to claim 1 characterized by being the bowl-like ellipse reflector from which eccentricity differs by length and its side.
[Claim 6] the liquid crystal projector according to claim 5 characterize by have the circular mirror of the concave internal reflection side arrange so that it may have the slit extend in the expanding direction of said stripe only into the part along which the flux of light in the external focus of said ellipse reflector pass and the core of the radius of curvature may be in agreement with the internal focus of said ellipse reflector , and the collimator lens which make this flux of light a parallel ray on the lower stream of a river of said circular mirror between said optical separation means and said ellipse reflector .
[Claim 7] Said liquid crystal panel is a liquid crystal projector according to claim 1 characterized by having the include-angle accommodation means which makes adjustable whenever [to said main optical axis of the principal plane / tilt-angle].
[Claim 8] The liquid crystal projector according to claim 1 characterized by having a scale-factor accommodation means to change the scale factor of a down-stream incident light study system between said rotating prism and said liquid crystal panel.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention penetrates the flux of light to a liquid crystal panel, and relates to the liquid crystal projector which projects this transmitted light to a screen according to a projection optical system.
[0002]
[Description of the Prior Art] As a liquid crystal projector, red and the thing of 3 liquid crystal panel methods which form simultaneous [to three liquid crystal panels which correspond a blue three-primary-colors image] green, and these liquid crystal panels and a corresponding filter are made to pass the same parallel flux of light, and carry out additive color mixture to them and which are projected to a screen by the down-stream incident light study system are known. With the liquid crystal panel of these 3 color, the monochrome image according to red, green, and blue individual is reproduced by point sequential, respectively.
[0003] Furthermore, a single liquid crystal panel as shown in drawing 1 as a liquid crystal projector, Irradiate the flux of lights R, G, and B of three colors of R (red), G (green), and B (blue) at parallel on the side face of the prism which consists of prism of a square cross section and rotates, and these parallel refracted light is irradiated in the shape of an ellipse spot on a liquid crystal panel. It scans so that the ellipse spot of three colors may move in a liquid crystal panel top. The image stripe simultaneously inserted into the protection-from-light band It synchronizes with an ellipse spot. A projection image The liquid crystal projector of the single liquid crystal panel method to obtain is also developed ("A novel single light valvehight brightness HD color projector"P.Janssen, PP-249-252).
[0004] As shown in drawing 1 , this single liquid crystal panel method liquid crystal projector The metal halide lamp 1 of the source of the white light, and the reflector 2 of the shape of a semi-sphere side collected to down-stream optical system by making light into the thin flux of light, The dichroic prism 3 which is the optical separation means which divides focusing light into the RGB flux of light, The mirrors 4 and 5 which make parallel light divided RB flux of light at G flux of light, and the rotating prism 6 of a square cross section, It has the anamorphic lens 7 which makes the RGB flux of light ellipse spot-like, the liquid crystal panel 8 which displays the monochrome image partial stripe corresponding to a RGB ellipse spot, and the projector lens 9. The revolving shaft A of prism 6 lies at right angles to the optical axis of the flux of light of G. A reflector 2 condenses the light from a lamp 1 to the down-stream liquid crystal panel 8, and the intermediate anamorphic lens 7 changes the aspect ratio of a flux of light cross section, and it forms the ellipse spot on a liquid crystal panel 8. namely, the line between the lamp discharge electrodes which are on an optical axis in a single liquid crystal panel method liquid crystal projector -- the place where the light from a luminescence field should serve as a circular spot on a liquid crystal panel 8 is formed as an ellipse spot elongated to landscape orientation (the direction of a normal of a drawing) by the anamorphic lens 7. Since an ellipse spot is irradiated so that the image stripe of the rectangle currently formed in the liquid crystal panel may be inscribed in the ellipse spot concerned, quantity of light loss is not escaped, but in order to prevent a cross talk further, it must interrupt the periphery of an ellipse spot with the protection-from-light band of an image stripe.
[0005] In the method (henceforth a RGB parallel method) which carries out incidence of this RGB flux of light to parallel at prism, the white light is condensed to a dichroic prism 3, it divides into the RGB flux of light, and incidence of the flux of light is carried out to a rotating prism 6 at parallel. Since the parallel displacement of the ellipse spot flux of light of RGB is turned to sequence down from on a liquid crystal panel by revolution of prism, 90-degree revolution of prism returns one period. The vertical scanning of

each ellipse spot light is turned down from a top 4 times by one revolution of prism 6.
[0006] Here, according to the ellipse spot width of face of RGB of a vertical scanning, on a liquid crystal panel 8, one by one, the stripe partial image of three colors corresponding to a part of three-primary-colors image is formed, and the ellipse spot light of RGB of a vertical scanning penetrates a liquid crystal panel, projects to a screen 10 by the incident light study system 9, and forms a full color image by the vertical scanning of the stripe partial image of three colors.
[0007] Moreover, the optical system of the rotating prism of this RGB parallel method is designed [to] in consideration of an optical path, when becoming far gradually (****), as it is shown in drawing 2 C and D from from, when RB secondary optical axis approaches G main optical axis and the flux of light carries out incidence of the RB as two suboptical axis by using G as the main optical axis (paraxial), as shown in drawing 2 A and B. Change of the exposure location of the ellipse spot S of RGB on the liquid crystal panel by the prism revolution corresponding to each optical path is shown in the left of drawing 2 .
[0008] That is, when the refractive index of the prism in paraxial incidence is small (drawing 2 A) or large (drawing 2 B), the flux of light approaches, since incidence is carried out, ellipse spot width of face on a panel (minor axis) cannot be enlarged, but it becomes difficult to make a screen bright. Since spacing between BR of a ****** RGB group becomes large and RB incidence location differs from G incidence location by paraxial incidence when the rate of prismatic refraction is large (drawing 2 B), there is a problem from which the location of upper part feedback of the ellipse spot after a vertical scanning differs by RB and G.
[0009] By the single liquid crystal panel method in the **** incidence shown in drawing 2 C and D Since the flux of light of BR secondary optical axis carries out incidence to the prism other than the problem of the location of upper part feedback of the ellipse spot of RB secondary optical axis at the big include angle to 90 abbreviation There is neither a problem to which a color gap becomes large in the scan initiation or termination on a panel by distribution, nor an antireflection film which can cover a large frequency domain by whenever [45 degrees or more angle-of-incidence], and the acid-resisting measure of incident light is impossible, and has the problem of quantity of light loss. Moreover, by **** incidence, when the refractive index of prism is small (drawing 2 C), the flux of light of a suboptical axis cannot acquire the outgoing radiation optical path from parallel Men whom prism counters (refer to optical-path f), but there is a problem by which an ellipse spot is not formed on a liquid crystal panel.
[0010] By **** incidence, even when the refractive index of prism is large (drawing 2 D), there is a problem by which the ellipse spot of RB secondary optical axis is not formed on a liquid crystal panel. That is, as shown in drawing 3 and drawing 4 , when prism rotates from zero angle of rotation, the vertical scanning of include-angle within the limits until, as for a RGB ellipse spot, B flux of light in prism reaches an optical axis from parallel (drawing 3 A, drawing 4 A) at the top-most-vertices edge e of the prism downstream is carried out to parallel like drawing 3 B and drawing 4 B. If B flux of light probe index reaches the edge d of the prism upstream, as shown in drawing 3 C and drawing 4 C, incidence of the B flux of light is carried out from a prism underside across the top-most vertices of the prism underside upstream, and a high refractive index, therefore refracted B flux of light will go across the prism edge e temporarily, and it will carry out outgoing radiation to an optical axis at parallel from method parallel Men of the improvement in a pair, the plane of incidence of B flux of light. However, if it rotates further, as shown in drawing 3 D and drawing 4 D, B flux of light in which the prism edge e was refracted is crossed, outgoing radiation of the B flux of light will not be carried out from method parallel Men of the improvement in a pair, but it will be reflected in the contact surface of plane of incidence, without becoming in parallel with RG flux of light. The prism edge e which furthermore rotates and refracted R flux of light shows to drawing 3 E and drawing 4 E is reached, and as shown in drawing 3 F and drawing 4 F, R flux of light as well as B flux of light of drawing 3 D is reflected in the contact surface of the plane of incidence. After that, RB flux of light does not reach a liquid crystal panel, but only G flux of light forms an ellipse spot on a panel. If a prism angle of rotation amounts to 45 degrees (drawing 3 G and drawing 4 G), outgoing radiation of the G flux of light will be carried out to a shaft at parallel from method parallel Men of the improvement in a pair, the plane of incidence. Thus, in the case of high refractive-index prism, the ellipse spot of the flux of light of RB secondary optical axis may not be formed on a liquid crystal panel by **** incidence. In addition, drawing 4 shows change of height h from the main optical axis in prism to the outgoing radiation point of the RGB flux of light in the range to 90 angles of rotation by making into criteria (0 times) the time when a prism side face is vertical to the main optical axis. In the RGB curve of drawing 4 , it is shown that, as for a continuous-line part, an ellipse spot is formed on a panel corresponding to the outgoing radiation height of the RGB flux of light, and, as for the broken-line parts Rn and Bn, an ellipse spot is not formed on a panel,

but RB flux of light is reflected. Moreover, arrow-head A-G of drawing 4 shows the prism angle-of-rotation location shown in drawing 3 A-G.

[0011] Thus, in any case, in the single liquid crystal panel mold projector of a RGB parallel method, forming a parallel RGB ellipse spot in a panel has many problems, the incidence location of the flux of light of a suboptical axis has many limits in the refractive index and magnitude list of a rotating prism, the degree of freedom of a design is small, and a design is difficult.

[0012]

[Problem(s) to be Solved by the Invention] In this single liquid crystal panel method liquid crystal projector, as shown in drawing 1 , a metal halide lamp 1 is placed in accordance with the main optical axis in the longitudinal direction, and the paraboloid-like symmetry-of-revolution reflector 2 is used. Although between discharge electrodes is contracted and it is necessary to miniaturize a paper lantern mold lamp part in the conventional light source which made the longitudinal direction of a metal halide lamp 1 in agreement with an optical axis in order to raise the condensing engine performance, there is a limitation in it, and the electrode protection part extended in the direction of an optical axis of both sides from a paper lantern mold lamp part causes protection from light and light scattering, and has become not only the condensing engine performance but loss of the quantity of light. To reduce quantity of light loss of the flux of light which penetrates an optic, and to secure the quantity of light is desired in the liquid crystal projector.

[0013] Moreover, in the curvilinear part the starting point location of the vertical scanning of the ellipse spot of the flux of light of RB secondary optical axis on a liquid crystal panel indicates further the incidence location to the rotating prism of the flux of light of a suboptical axis to be to M of drawing 5 , and N unlike it of G optical axis as shown in drawing 5 even if it sets an incidence location as the mean instead of **** or paraxial, the ellipse spot of BR does not serve as exposure passing speed equal to it of G. The variation in the exposure passing speed of this ellipse spot generates the ununiformity of the brightness of BR spot, and causes color nonuniformity of a projection image.

[0014] Then, that the above-mentioned trouble should be solved, the object of this invention maintains spacing of a RGB ellipse spot at homogeneity, and is to offer the liquid crystal projector in which the linearity of those exposure passing speed does not have high color nonuniformity with a bright projection screen, either.

[0015]

[Means for Solving the Problem] The reflector which the liquid crystal projector of this invention reflects the light from the light source and the light source, and is made to condense, The condensed flux of light Red and an optical separation means to separate into the flux of light of green and three blue colors, Become a liquid crystal panel and a revolving shaft from the pillar-shaped object of the regular-polygon cross section which has an opposite parallel side by axial symmetry, and receive the flux of light of said three colors in the side face, and these are irradiated in the shape of a stripe on said liquid crystal panel. Are the liquid crystal projector to which it has the rotating prism which scans the stripe of three colors on said liquid crystal panel, and said revolving shaft and this main optical axis cross at right angles by using one of the flux of lights of said three colors as the main optical axis, and two in which the flux of light of said three colors remains are used as a suboptical axis. The liquid crystal projector characterized by having the incidence means which the symmetry is made to incline to said main optical axis, and carries out incidence of this suboptical axis at the intersection of said main optical axis and said revolving shaft, and a set means to gather said suboptical axis to said main optical axis at parallel.

[0016]

[Function] According to this invention, the starting point location of the vertical scanning of the stripe flux of light of RGB on a liquid crystal panel is fixed, and those spacing is almost fixed, and a liquid crystal projector also with the high linearity of exposure passing speed is obtained. That is, according to this invention, all vertical scannings become possible with an equal speed, stripe width of face and spacing can be set up more widely than a RGB parallel method, and a liquid crystal projector without color nonuniformity with a bright projection screen is obtained.

[0017]

[Example] The example by this invention is explained to it, referring to a drawing to below. The liquid crystal projector of the RGB crossover method by this example is shown in drawing 6 . The member shown with the same sign shown in drawing 1 in drawing 6 shows the same thing. The RGB crossover method single liquid crystal panel liquid crystal projector is equipped with the light source optical system containing the bowl-like ellipse reflector 12 from which eccentricity differs by the metal halide lamp 11 of the white light source, the length for making light from the light source into the thin flux of light, and its side.

Moreover, the rotating prism 6 with which this example makes the flux of light scan and the dichroic prism 3 which is the means which divides the white flux of light into the flux of light of RGB, Turned to the rotating prism 6 the suboptical axis of RB divided by this, the symmetry was made to incline to the main optical axis of G, and it has the rotating-prism system including the mirrors 14 and 15 of the couple which carries out incidence so that a revolving shaft A may be made to intersect, and the set means which makes the suboptical axis of RB in agreement with the main optical axis of G. The set means concerned consists of the 2nd reflective mirror 21 and 22 which is arranged mirrors 14 and 15 and conjugate about a dichroic prism 23, and the 2nd main optical axis and revolving shaft A on the main optical axis, and shows the suboptical axis of RB to the 2nd dichroic prism 23, and makes these in agreement with the main optical axis of G. Moreover, this example is equipped with the exposure optical system which consists of the anamorphic lens 7, the liquid crystal panel 8, and projector lens 9 which have been arranged on the suboptical axis of congruous RB(s), and the main optical axis of G.

[0018] although the prism which has a dip multilayered film is used so that both the dichroic prisms 3 and 23 may be looked like [the wavelength component which makes parallel pass incident light as it is according to the wavelength, and two wavelength components reflected in an opposite direction at right angles to incident light, respectively] here and it may divide (a wavelength component is made to superimpose further -- as), what is necessary is just not only this but being able to divide into three wavelength components

[0019] Below, light source optical system, a rotating-prism system including a set means, and exposure optical system are explained in full detail.

(Light source optical system) Light source optical system makes a liquid crystal panel top first the configuration suitable for irradiating by the linear shape of a stripe of a narrow width. As shown in drawing 7 , in the system of coordinates which made the Z-axis in agreement with the main optical axis, made the stripe expanding direction vertical to the main optical axis on a liquid crystal panel in agreement with the X-axis, and made the direction of a vertical scanning of a stripe in agreement with a Y-axis, the ellipse reflector 12 is the reflective mirror of the bowl configuration which has the reflective inner surface to which the eccentricity of a vertical Y-axis serves as smallness from the eccentricity of the horizontal X-axis. With the focus P of the ellipse reflector 12 interior, the long and slender metal high RAIDO lamp 11 carries out the longitudinal direction every width so that it may become parallel to the stripe which should be formed. In respect of YZ including a stripe scanning direction, paper lantern mold light-emitting part 11a of the center of a lamp is put on the internal focus P of the ellipse reflector 12, and it considers as the optical system which leads fundamentally the luminescence pattern of long and slender paper lantern mold light-emitting part 11a to a liquid crystal panel as it is. For this reason, the condensing engine performance of the direction of Y becomes high. In respect of XZ, light is fundamentally guided in the direction of a liquid crystal panel with a long luminescence configuration. Therefore, with the external focus Q of the ellipse reflector 12, the long and slender condensing field of a Z direction is obtained. Thereby, although the stripe width of face on a liquid crystal panel becomes what has a more high consistency, further, in consideration of the effective diameter of down-stream optical system, the small anamorphic optical system of refractive power is arranged in front of a liquid crystal panel rather than before, and it can adjust.

[0020] Furthermore, the maximum exposure line breadth of the stripe in a liquid crystal panel is made thin to the image display part and equivalent extent of a stripe on a liquid crystal panel, and the quantity of light per unit area of a screen is made to increase by the below-mentioned collimating system in this example. Since it irradiates with a line stripe by this example unlike the method which irradiates liquid crystal panels, such as 3 panel systems, in a field, the energy per unit area of light and heat becomes high.

[0021] Light source optical system is equipped with the collimator lens 17 as shown in drawing 6 and 7, and it has the circular mirror 16 of a concave internal reflection side between a collimator lens 17 and the ellipse reflector 12 for heat protection of a liquid crystal panel and an optic. The circular mirror 16 has slit 16a extended in the direction of X only into the part along which the flux of light in the external focus Q passes, and the core of the radius of curvature is arranged so that it may be in agreement with the internal focus P of an ellipse reflector. The light which this attains from a lamp 11 to the direct circular mirror 16 is reflected in Focus P, and it uses again as an effective light. A collimator lens 17 changes into the tabular parallel pencil of rays on XZ side the divergence light which carried out outgoing radiation from slit 16a.

[0022] Light source optical system is equipped also with the polarization beam splitter (PBS) 18 which penetrates only P polarization of a parallel pencil of rays which carried out outgoing radiation from the collimator lens 17 further as shown in drawing 6 and drawing 8 . P polarization is used because the amount of transparency of any one polarization of P or the S polarization is modulated in a down-stream liquid

crystal panel. Moreover, the cold mirror 19 which returns light to the light source for a quantity of light deployment is formed in the previous PBS side which S polarization reflected in the PBS18 interior. The parallel pencil of rays of this P polarization is guided to a dichroic prism 3.
[0023] Although it has the circular mirror 16 and PBS18 in the above-mentioned example for the cure against heat, and the increment in the quantity of light to coincidence, it is effectively good also as a configuration using S polarization as shown in drawing 9 . After changing the optical path of the ejection from a previous PBS side and S polarization by the mirror 30 by S polarization instead reflected in the interior of PBS except for the cold mirror of PBS18 and carrying out S polarization to P polarization with lambda/2 wavelength plate 31, this P polarization and P polarization by PBS18 are compounded by the V character cross-section pillar-shaped lens 32 and the collimator lens systems 33 and 34. Both P polarization becomes parallel in the V character cross-section pillar-shaped lens 32 interior, and it converges with a lens 33 and becomes a parallel pencil of rays with a lens 34. Moreover, although considered as lambda/2 wavelength plate 31 here, the phase adjustment thin film of several layers may be actually prepared in the front face of the reflective mirror 30 instead of lambda/2 wavelength plate, 90 degrees of phases of light to reflect may be made to change, and assembly components will decrease in number by this.
(Rotating-prism system) The rotating-prism system has the main optical axis 51 of G, and the suboptical axis 52 and 53 of RB, as shown in drawing 10 . Dichroic prisms 3 and 23 and the reflective mirrors 14, 15, 21, and 22 have specified the main optical axis 51 and the suboptical axis 52 and 53. Mirrors 14 and 15 turn to a rotating prism 6 the suboptical axis of RB vertical to the main optical axis 51 divided with the dichroic prism 3, respectively, make the symmetry incline at an include angle theta to the main optical axis 51 of G, and are made to intersect a revolving shaft A. Therefore, the deflection of the flux of light which carries out incidence in accordance with each main optical axis and a suboptical axis serves as equivalence about the angle of rotation of a rotating prism.
[0024] In the liquid crystal projector shown in drawing 6 , the suboptical axis of RB inclines in the symmetry to the main optical axis of G at the include angle theta of 30 degrees, respectively. Drawing 11 (A) Some optical-path conditions of angle-of-rotation within the limits from zero prism angle of rotation in the rotating-prism system of drawing 6 to 45 degrees are shown in - (E). All are known by that the vertical scanning of the RGB flux of light is carried out to parallel.
[0025] The graph of change of the location (height) from the main optical axis of the RGB flux of light which the RGB flux of light in the rotating-prism system of drawing 6 makes 0 times incidence and the prism angle of rotation which carries out outgoing radiation, and carries out outgoing radiation to drawing 12 from prism in the range to 90 angles of rotation at parallel is shown. In the RGB curve of drawing 12 , it turns out that a stripe is formed on a panel corresponding to the outgoing radiation height of the RGB flux of light, and abbreviation etc. is by carrying out, and a vertical scanning is carried out to parallel at spacing. Moreover, - (E) shows the prism revolution location of (A) (A) - (E) of drawing 12 . [which is shown in drawing 11]
[0026] Moreover, as shown in drawing 9 , antireflection film 6a is attached to a rotating prism. Since the rotating prism which is the pillar-shaped object of a square cross section symmetrical with a line is used for the revolving shaft which has an opposite parallel side by the RGB crossover method of an example, whenever [beam-of-light incident angle] is a maximum of 45 degrees, and it is possible to attach antireflection film 6a on the surface of a rotating prism. There is no antireflection film which can cover a large frequency domain by whenever [45 degrees or more angle-of-incidence] although the flux of light of a suboptical axis carries out incidence by whenever [45 degrees or more angle-of-incidence] by the conventional RGB parallel method to it, and although the acid-resisting measure was impossible, an acid-resisting measure becomes possible by this invention.
[0027] The nonlinear degree of exposure passing speed is shown in drawing 13 . When G of the RGB flux of light is mentioned as an example and investigated, the conversion distance and conversion time amount of a stripe vertical scanning (the range of 0 - 90 degrees) over prism angle of rotation are [1.3mm and about 10 microseconds] maxes to linearity migration, respectively prism angle of rotation of 30 degrees, and near 60 degree. Therefore, these are not practically especially big conversion distance and conversion time amount which should be amended. If the compensation plate 50 formed in the outgoing radiation front face of the 2nd dichroic prism 23 with a transparence resin ingredient or glass is inserted and formed in a direct attachment or outgoing radiation side as shown in drawing 10 when effect comes out, a motion of the flux of light will become perfect linearity. The profile of the perpendicular direction cross section of a compensation plate 50 is formed based on the nonlinear degree shown in drawing 1313 .
[0028] Drawing 14 (A) Arrangement of each part material of the rotating-prism system at the time of

changing theta to - (D) in [include-angle] 0<=theta<=45 degrees whenever [tilt-angle / of the suboptical axis 52 and 53 over the main optical axis 51 shown in drawing 10] is shown. Whenever [tilt-angle], at theta**0 times and theta**45 degrees, since each part material serves as contiguity or a distant place, therefore, each part material is suitably arranged in the starting range which cannot arrange a mirror. Drawing 1515 (A) - (D) shows the graph of change of the outgoing radiation height of the RGB flux of light over the angle of rotation of a rotating prism corresponding to the arrangement of each part material of a rotating-prism system shown in drawing 14 (A) - (D).
[0029] whenever [tilt-angle / of the suboptical axis corresponding to / as shown in drawing 15 (A) and (D) / drawing 14 (A) and (D)] -- theta= 45 degrees and theta= 0 times -- coming out -- it will become one stripe, without RB flux of light and the RGB flux of light dissociating. Whenever [tilt-angle / of a suboptical axis], at theta**0 times, the RGB flux of light approaches, respectively, and it superimposes and it turns out [whenever / theta**45 degree and tilt-angle] that it is not desirable so that clearly from these.
[0030] Whenever [tilt-angle / of the suboptical axis corresponding to drawing 14 (B)], as shown in drawing 15 (B), although RB flux of light dissociates, the case where it does not become equal to the case where spacing of spacing of RB flux of light, G flux of light and R, or B becomes equal appears by turns, and causes CHIRATSUKI of a screen at 30 < theta< 45 degrees. At 30< theta<45 degrees, it turns out that the RGB flux of light becomes [spacing] an ununiformity and is not desirable whenever [tilt-angle] so that clearly from drawing 15 (B).
[0031] On the other hand, whenever [tilt-angle], at theta= 30 degrees, it is regular intervals also within the group of the RGB flux of light, and a scan is performed by at equal intervals also in RB spacing after RGB feedback so that clearly from drawing 12 . Although RB spacing after RGB feedback becomes large at 0< theta<30 degrees so that still more clearly from drawing 15 (C), within the group of the RGB flux of light, it turns out that a scan at equal intervals is performed. Therefore, whenever [tilt-angle / of the suboptical axis 52 and 53 over the main optical axis 51] may be chosen in [include-angle] 0< theta<=30 degrees in consideration of contact of each part material, magnitude, etc.
[0032] As other examples, as shown in drawing 16 , replace with the dichroic prism 3 list of the expensive couple shown in drawing 10 23, and respectively cheap dichroic mirror 3a and 3b list are made to change the reflective mirrors 14, 15, 21, and 22 which arrange 23a and 23b on the main optical axis 51, and correspond in accordance with the suboptical axis 52 and 53, and it can constitute so that the shaft of the flux of light of incidence and outgoing radiation may be made in agreement. The 2nd dichroic prism 23 and reflective mirrors 21 and 22 are because it is arranged about the revolving shaft A of a rotating prism 6 conjugate at a dichroic prism 3 and the reflective mirrors 14 and 15 in the main optical axis 51, each shaft is equivalent, so the optical path length of each shaft does not ask. Moreover, only one side of the dichroic prism of a couple may be permuted by the dichroic mirror.
[0033] Although the rotating prism which is the pillar-shaped object of a square cross section is used by the RGB crossover method shown in drawing 10 of the above-mentioned example, it replaces with this and can constitute using the rotating prism which is the pillar-shaped object of regular-polygon cross sections, such as a forward hexagon symmetrical with a line, and a forward octagon, in the revolving shaft which has an opposite parallel side. Make a suboptical axis incline in the symmetry to the main optical axis by using RB as a suboptical axis in the above-mentioned example, using G of the RGB flux of light as a suboptical axis, and make a prism revolving shaft intersect, and since a suboptical axis is arranged so that it may be in agreement with parallel at the main optical axis In the case of square cross-section prism, whenever [maximum incident angle / of the flux of light] is 45 degrees, the vertical scanning of the RGB flux of light of one period is obtained in the include-angle range which is 0< theta<=90 degrees, theta is 90 degrees / 3= 30 degrees whenever [symmetry tilt-angle / of a suboptical axis], and the vertical scanning of the RGB flux of light is obtained at equal intervals (period). Therefore, when the pillar-shaped object rotating prism 60 of a forward hexagon cross section is used as an example using other regular-polygon cross-section prism as shown in drawing 17 for example, whenever [maximum incident angle / of the flux of light] is 30 degrees, the vertical scanning of the RGB flux of light of one period is obtained in the include-angle range which is 0< theta<=60 degrees, theta is 60 degrees / 3= 20 degrees whenever [symmetry tilt-angle / of a suboptical axis], and a vertical scanning at equal intervals is obtained. The member shown with the same sign shown in drawing 6 R> 6 in drawing 17 shows the same thing. Moreover, when the pillar-shaped object rotating prism of a forward octagon cross section is used, whenever [maximum incident angle / of the flux of light] is 22.5 degrees, the vertical scanning of the RGB flux of light of one period is obtained in the include-angle range which is 0< theta<=45 degrees, theta is 45 degrees / 3= 15 degrees whenever [symmetry tilt-angle / of a suboptical axis], and a vertical scanning at equal intervals is obtained.

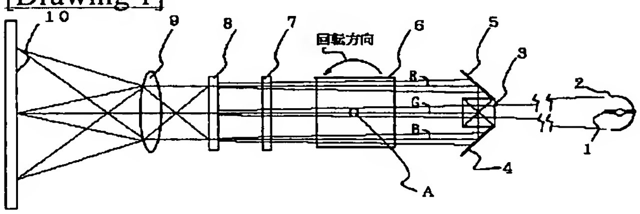
[0034] When using the regular-polygon cross-section prism exceeding a forward square of a forward hexagon and a forward octagon, it becomes higher than the case where the nonlinear degree of the passing speed of the stripe flux of light on a liquid crystal panel is forward square cross-section prism. It is because the distance of the semidiameter correction of the corresponding circumscribed circle of a regular polygon and an inscribed circle decreases more and conversion radial [in the prism side of incoming beams] decreases. Therefore, it becomes, without forming a compensation plate in the outgoing radiation front face of the 2nd dichroic prism.
(Exposure optical system) Although incidence of the sheet-like RGB flux of light is carried out to the liquid crystal panel 8 of a liquid crystal projector shown in drawing 6 , when projecting stripe width of face on a liquid crystal panel 8 vividly further, it is arranged on the main optical axis of RGB whose anamorphic lens 7 corresponded. Since this anamorphic lens is the optical system which produces the image with which the scale factors of a lengthwise direction and a longitudinal direction differ on the image surface, it is performed to a design and coincidence of a light source part. An anamorphic lens is one of the scale-factor accommodation means which changes the scale factor of an incident light study system just before a liquid crystal panel.
[0035] A liquid crystal panel 8 can also prepare magnifying lens 7a between a projector lens 9 and a rotating prism 6 as further scale-factor accommodation means, in order to maintain optics, such as a comparatively small rotating-prism system, small, since it is necessary to enlarge in order to gather the permeability of light further in order to make [many] the number of pixels, and to make it bright. Thereby, the consistency of enlargement of a liquid crystal panel and a miniaturization of a rotating-prism system etc. can be taken.
[0036] The liquid crystal panel of the TFT (Thin Film Transistor) method of response-time 2.5 ms is used, for example, if a liquid crystal panel 8 is 60mm(horizontal) x34mm (perpendicular direction) magnitude When stripe exposure area is [the duty ratio of a partial graphic display part and a protection-from-light part] 1:1 as magnitude within 60mm(horizontal) x15mm (perpendicular direction), 60mm(horizontal direction) x5.7mm (perpendicular direction) magnitude turns into magnitude of a partial graphic display part and a protection-from-light part. A stripe is for the range which does not exceed the protection-from-light part of the vertical both sides of the graphic display part of a liquid crystal panel irradiating, and making it a cross talk not arise. Since according to this example the tabular (the shape of a sheet) RGB flux of light is made to generate from the light source and incidence of the RGB flux of light to the revolving shaft of a rotating prism is performed, it can set up more widely than the case where setting out of the duty ratio of a partial graphic display part and a protection-from-light part is the conventional RGB parallel method.
[0037] Moreover, as shown in a liquid crystal panel 8 at drawing 6 , the include-angle accommodation means 70 which makes adjustable the include angle to the main optical axis of the principal plane is established. A liquid crystal panel 8 is supported pivotably with a journal by the revolving shaft on the main optical axis, for example, and the include-angle accommodation means 70 drives for example, the soffit edge of a liquid crystal panel 8 in accordance with the main optical axis. Even if the normal of a screen 10 inclines the principal plane of a liquid crystal panel 8 to the main optical axis since it is a single liquid crystal panel method when an include angle is changed to the main optical axis as shown in drawing 18 , an image without a keystone distortion can be acquired.
(A liquid crystal panel and prism drive system) A liquid crystal projector has the RGB conversion circuit 100, frame buffer memory 101R, 101G, and 101B, the stripe signal selection circuitries 102R, 102G, and 102B, a controller 103, the time amount compression circuits 104R, 104G, and 104B, the time-sharing circuit 105, the liquid crystal panel actuation circuit 106, and the prism driving means 107, as shown in drawing 6 .
[0038] The RGB conversion circuit 100 containing an A/D converter divides for example, an NTSC signal video signal into the digital signal of R, G, and B, and each signal is written in frame buffer memory 101R, 101G, and 101B. The stripe signal selection circuitries 102R, 102G, and 102B carry out the selection extract of the brightness data of the up part raster of R image, the center-section part raster of G image, and the lower part raster of B image according to the selection command from a controller 103, respectively from these writing ** rare ** frame data. The time amount compression circuits 104R, 104G, and 104B compress these extract data according to the compression command from a controller 103, respectively. The time-sharing circuit 105 containing a selector, a delay circuit, a multiplexer, and a D/A converter sets all the ** (ed) partial raster data to one based on the selection command from a controller 103, and transmits it to the actuation circuit 106 of a liquid crystal panel. The actuation circuit 106 carries out the vertical scanning of the stripe image formed with the partial raster data of the brightness of each RGB to a liquid crystal panel from a top to the bottom, and displays it on it to it.

[0039] The prism driving means 107 which carries out revolution actuation of the prism including a spindle motor and a revolution detector is connected to the controller 103. A controller 103 is synchronized with the vertical scanning of the stripe image of RGB, and carries out the vertical scanning of the stripe flux of light of the brightness of each RGB from a top to the bottom while it controls the prism driving means 107 and makes prism rotate based on the revolution data from a revolution detector. Then, the stripe of RGB is irradiated at each brightness information-display part of RGB of a liquid crystal panel, respectively, and a screen can be made from a top to the bottom. Thus, carry out sequential formation of the stripe partial image (partial raster) of three colors corresponding to a part of three-primary-colors image on a single liquid crystal panel, the flux of light of the shape of a stripe corresponding to a stripe partial image is made to penetrate synchronizing with a liquid crystal panel, and a full color image is made.
[0040] In order to solve that it is conspicuous with [of the color in the part of a color with the high saturation on a feeling of **] Zillah (color flicker), time amount compression of the decomposed three-primary-colors video signal is carried out one third, and a stripe is changed for frame frequency one by one as 3 times as many 180Hz as this. Furthermore, the phenomenon which a color attaches to the profile part of an image and which is called "color breakup" can also be controlled. It is set to the level which is setting frame frequency to 180Hz using a time amount compression circuit although it may be visible to the color from which the color with the actual profile section is different when migration of an image was quicker than the time amount which composition in three primary colors takes when gap of the image for every frame is large in this means of displaying, and hardly becomes a problem practically.
[0041]
[Effect of the Invention] The reflector which according to this invention reflects the light from the light source and the light source, and is made to condense like the above, The condensed flux of light Red, a means to separate into the flux of light of green and three blue colors, and a liquid crystal panel, Become a revolving shaft from the pillar-shaped object of the regular-polygon cross section which has an opposite parallel side by axial symmetry, and receive the flux of light of three colors in the side face, and these are irradiated in the shape of a stripe on a liquid crystal panel. In the liquid crystal projector to which it has the rotating prism which scans the stripe of three colors on a liquid crystal panel, and a revolving shaft and this main optical axis cross at right angles by using one of the flux of lights of three colors as the main optical axis Since it has the means which this suboptical axis is made to incline in the symmetry to the main optical axis by using as a suboptical axis two in which the flux of light of three colors remains, and carries out incidence at the intersection of the main optical axis and a revolving shaft, and a means to gather a suboptical axis to the main optical axis at parallel It is certainly formed on the conditions by which the stripe of RGB in a liquid crystal panel was eased, and the starting point location of the vertical scanning of the stripe flux of light is fixed, and spacing is almost fixed, a liquid crystal projector also with the high linearity of exposure passing speed is obtained, and a bright projection image can be obtained.

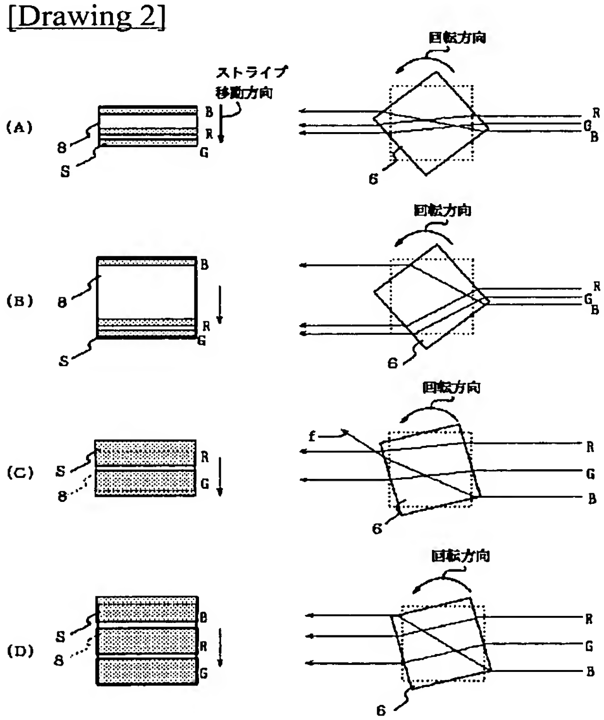
[Translation done.]

DRAWINGS

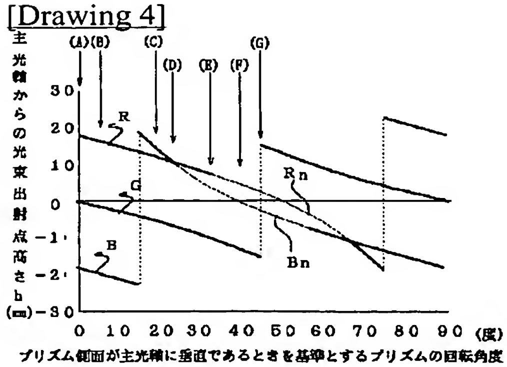
[Drawing 1]



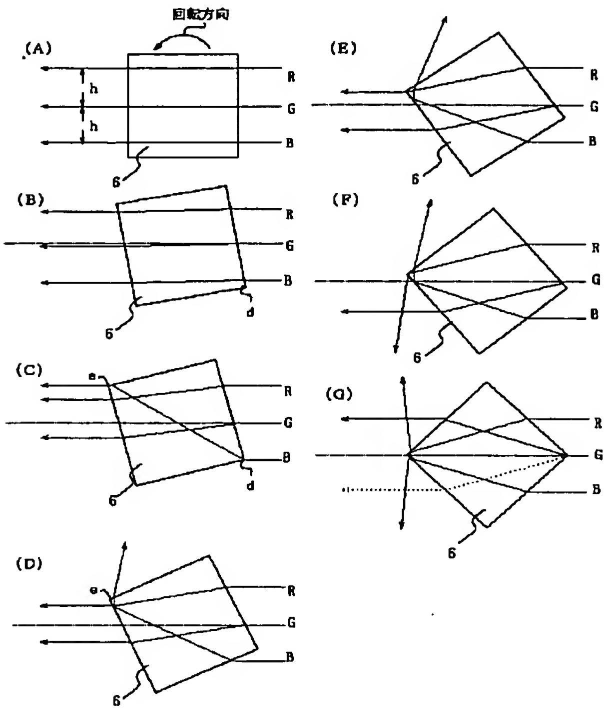
[Drawing 2]



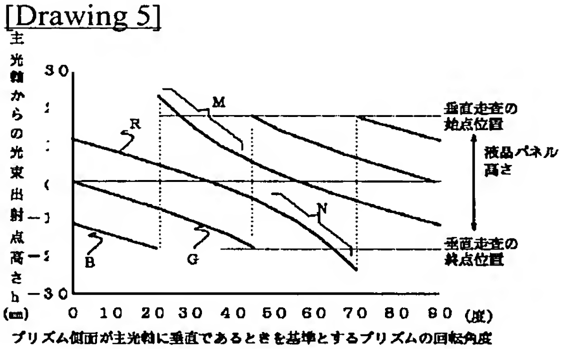
[Drawing 4]



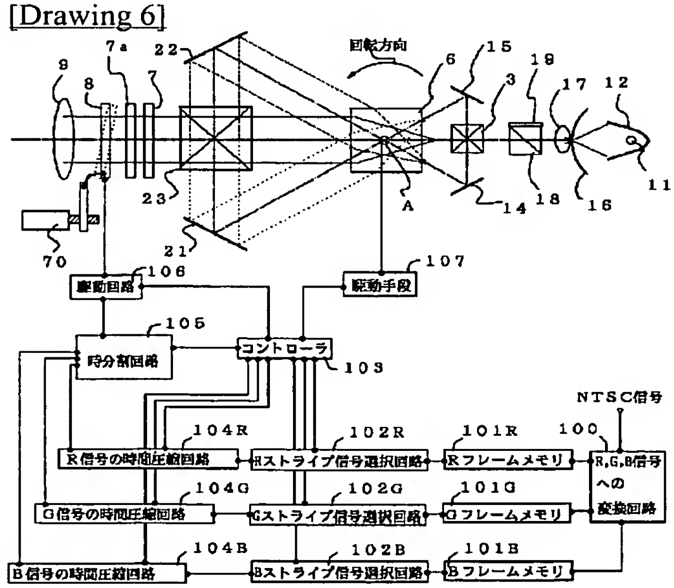
[Drawing 3]



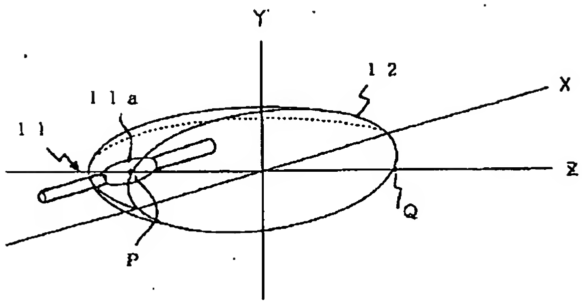
[Drawing 5]



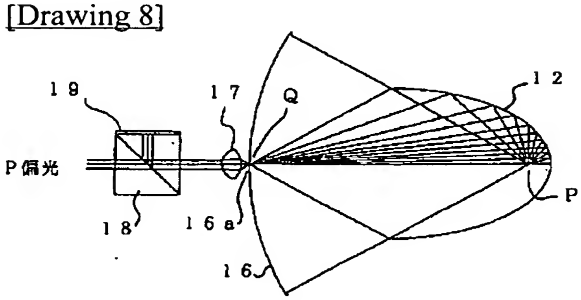
[Drawing 6]



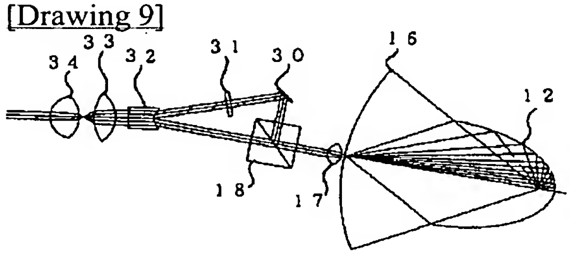
[Drawing 7]



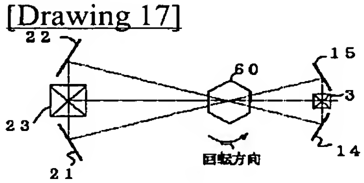
[Drawing 8]



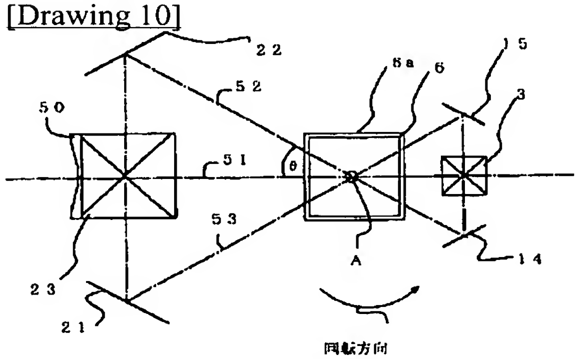
[Drawing 9]



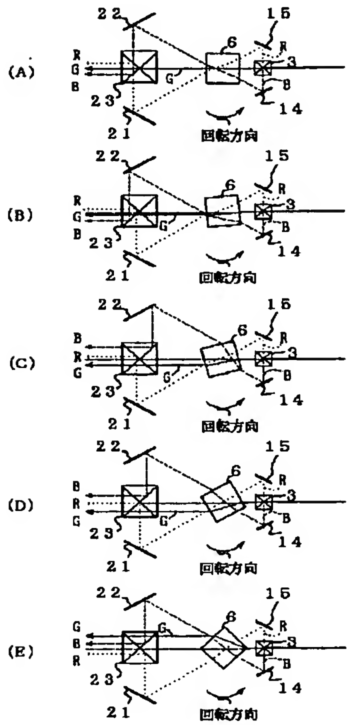
[Drawing 17]



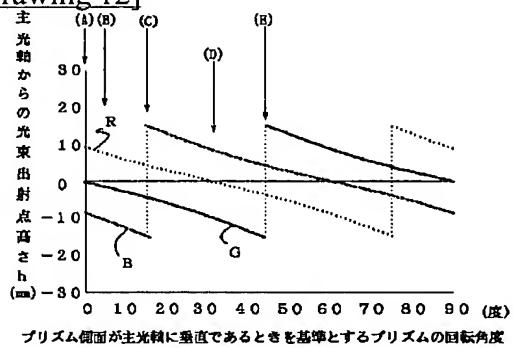
[Drawing 10]



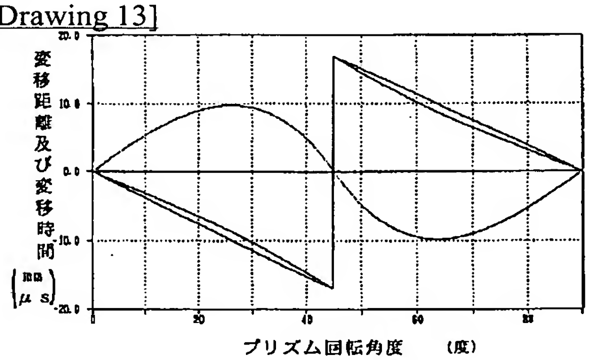
[Drawing 11]



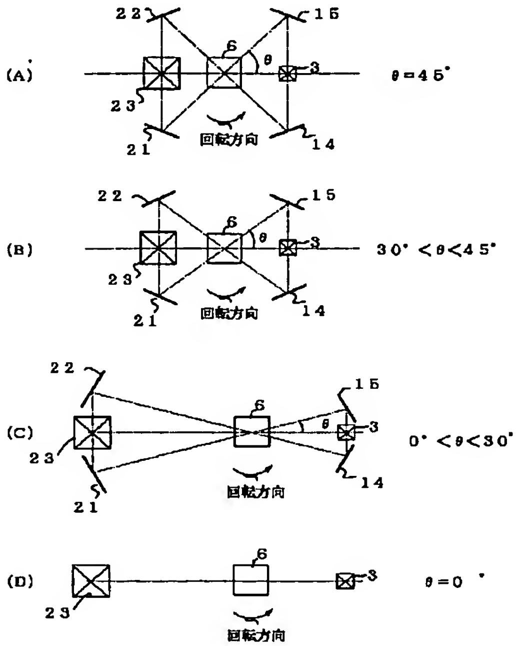
[Drawing 12]



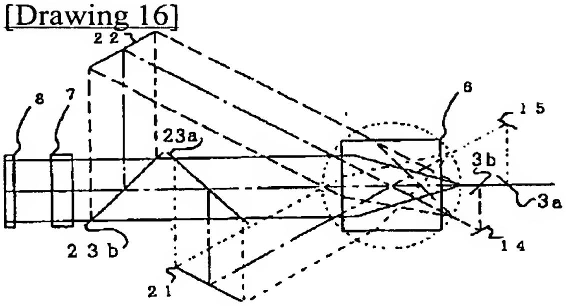
[Drawing 13]



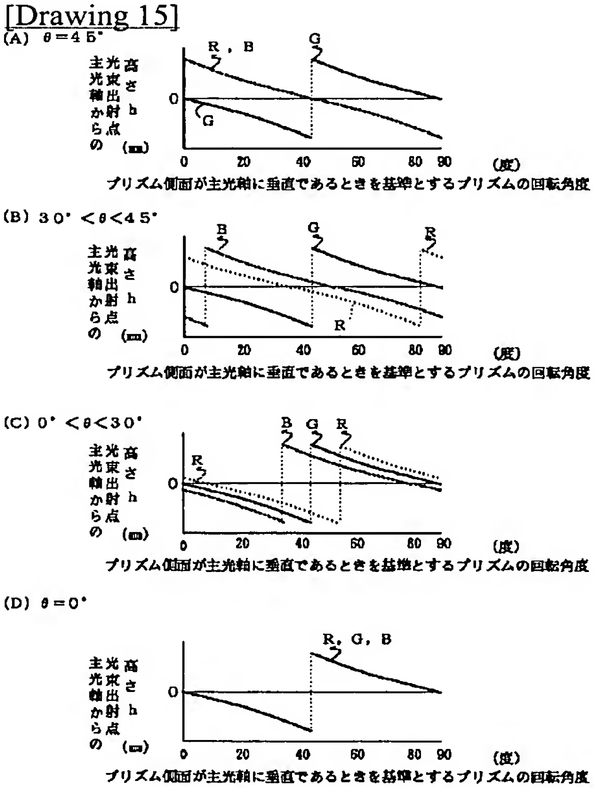
[Drawing 14]



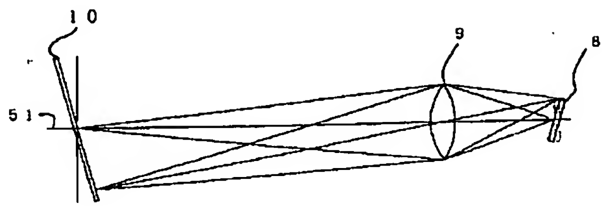
[Drawing 16]



[Drawing 15]



[Drawing 18]



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	1/13	５０５			

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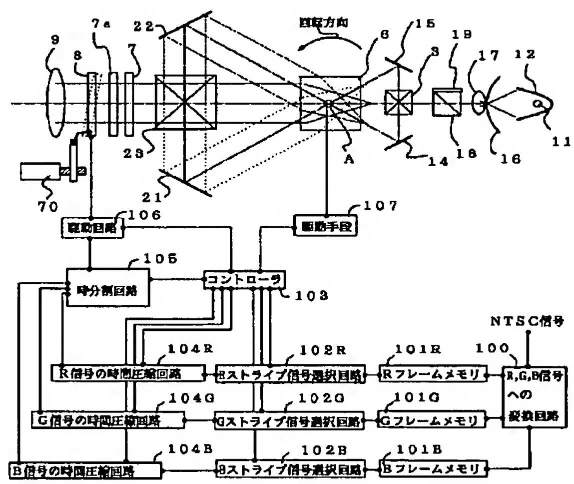
(54)【発明の名称】　液晶プロジェクタ

(57)【要約】

【目的】　液晶パネルでのＲＧＢストライプ光束の垂直走査の始点位置が一定でかつ間隔がほぼ一定で照射移動速度の線形性も高い液晶プロジェクタを提供する。

【構成】　光源と、光源からの光を反射し集光させるリフレクタと、集光された光束を赤、緑及び青の３色の光束に分離する手段と、液晶パネルと、回転軸に線対称で対向平行面を有する正多角形断面の柱状体からなりかつ、その側面に３色の光束を受けこれらを液晶パネル上にストライプ状に照射して、３色のストライプを液晶パネル上で走査する回転プリズムと、を有し、３色の光束の１つを主光軸として該主光軸が回転軸に直交する液晶プロジェクタであって、３色の光束の残る２つを副光軸として、該副光軸を、主光軸に対して対称に傾斜せしめかつ主光軸及び回転軸の交点に交差せしめる一対の入射手段と、副光軸を主光軸に平行に配置する集合手段とを備える。



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【特許請求の範囲】

【請求項１】　光源と、光源からの光を反射し集光させるリフレクタと、集光された光束を赤、緑及び青の３色の光束に分離する光分離手段と、液晶パネルと、回転軸に線対称で対向平行面を有する正多角形断面の柱状体からなりかつ、その側面に前記３色の光束を受けこれらを前記液晶パネル上にストライプ状に照射して、３色のストライプを前記液晶パネル上で走査する回転プリズムと、を有し、前記３色の光束の１つを主光軸として該主光軸が前記回転軸に直交する液晶プロジェクタであって、前記３色の光束の残る２つを副光軸として、該副光軸を、前記主光軸に対して対称に傾斜せしめかつ前記主光軸及び前記回転軸の交点に入射する入射手段と、前記副光軸を前記主光軸に平行に集合する集合手段とを備えることを特徴とする液晶プロジェクタ。

【請求項２】　前記回転プリズムは正方形断面の柱状体であることを特徴とする請求項１記載の液晶プロジェクタ。

【請求項３】　前記副光軸はそれぞれ$0<\theta\leqq 30$度の角度範囲で前記主光軸に対して対称に傾斜することを特徴とする請求項１記載の液晶プロジェクタ。

【請求項４】　前記副光軸はそれぞれ３０度の角度で前記主光軸に対して対称に傾斜することを特徴とする請求項３記載の液晶プロジェクタ。

【請求項５】　前記リフレクタは縦と横で離心率の異なる碗状の楕円リフレクタであることを特徴とする請求項１記載の液晶プロジェクタ。

【請求項６】　前記楕円リフレクタの外部焦点における光束の通る部分にだけ前記ストライプの伸長方向に伸びるスリットを有しかつ、その曲率半径の中心が前記楕円リフレクタの内部焦点と一致するように配置された凹内部反射面の円形ミラーと、前記円形ミラーの下流に該光束を平行光線とするコリメータレンズとを、前記光分離手段及び前記楕円リフレクタ間に、有することを特徴とする請求項５記載の液晶プロジェクタ。

【請求項７】　前記液晶パネルは、その主面の前記主光軸に対する傾斜角度を可変にする角度調節手段を備えることを特徴とする請求項１記載の液晶プロジェクタ。

【請求項８】　前記回転プリズム及び前記液晶パネル間で下流の投射光学系の倍率を変える倍率調節手段を備えることを特徴とする請求項１記載の液晶プロジェクタ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、光束を液晶パネルへ透過し、該透過光を投影光学系によりスクリーンへ投射する液晶プロジェクタに関する。

【０００２】

【従来の技術】液晶プロジェクタとしては、赤、緑及び青の３原色映像を、対応する３つの液晶パネルに同時に形成し、これら液晶パネル及び対応するフィルタに同一の平行光束を通過させ加色混合し、下流の投射光学系によって、スクリーンへ投射する３液晶パネル方式のものが知られている。これら３色の液晶パネルではそれぞれ点順次で赤、緑及び青の個別の単色映像を再現している。

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【０００３】さらに、液晶プロジェクタとしては、図１に示すような、単一の液晶パネルと、正方形断面のプリズムからなり、回転するプリズムの側面にＲ（赤）、Ｇ（緑）及びＢ（青）の３色の光束Ｒ、Ｇ及びＢを平行に照射し、これらの平行屈折光を液晶パネル上に長円形スポット状に照射して、３色の長円形スポットが液晶パネル上を移動するように走査して、同時に遮光帯に挟まれた映像ストライプを長円形スポットに同期し投射像を得る単一液晶パネル方式の液晶プロジェクタも開発されている（“A novel single light valve hight brightness HD color projector” P. Janssen, PP-249-252)。

【０００４】図１に示すように、かかる単一液晶パネル方式液晶プロジェクタは、白色光源のメタルハライドランプ１と、光を細い光束として下流の光学系へ集める半球面状のリフレクタ２と、集束光をＲＧＢ光束に分ける光分離手段であるダイクロイックプリズム３と、分けられたＲＢ光束をＧ光束に平行光とするミラー４，５と、正方形断面の回転プリズム６と、ＲＧＢ光束を長円形スポット状になすアナモルフィックレンズ７と、ＲＧＢ長円形スポットに対応する単色映像部分ストライプを表示する液晶パネル８と、投射レンズ９とを備えている。プリズム６の回転軸ＡはＧの光束の光軸に直交している。リフレクタ２はランプ１からの光を下流の液晶パネル８へ集光し、途中のアナモルフィックレンズ７が光束断面のアスペクト比を変化させて液晶パネル８上に長円形スポットを形成している。すなわち、単一液晶パネル方式液晶プロジェクタでは、光軸上にあるランプ放電電極間の線状発光領域からの光が液晶パネル８上で円形スポットとなるべきところを、アナモルフィックレンズ７によって横長方向（図面の法線方向）に伸長した長円形スポットとして形成している。長円形スポットは、液晶パネルに形成されている長方形の映像ストライプが当該長円形スポットに内接するように照射されるので、光量損失は免れず、さらにクロストークを防止するために長円形スポットの周縁を映像ストライプの遮光帯によって遮らなければならない。

【０００５】かかるＲＧＢ光束を平行にプリズムに入射する方式（以下、ＲＧＢ平行方式という）においては、白色光をダイクロイックプリズム３へ集光し、ＲＧＢ光束に分け、光束を回転プリズム６に平行に入射する。プリズムの回転によりＲＧＢの長円形スポット光束を液晶パネルの上から下へ順番に平行移動するので、プリズムの９０°回転が１周期で元に戻る。プリズム６の１回転で各長円形スポット光は４回、上から下へ垂直走査する。

【０００６】ここで、垂直走査のＲＧＢの長円形スポット幅に合わせて液晶パネル８上に順次、３原色映像の一部分に対応する３色のストライプ部分映像を形成して、垂直走査のＲＧＢの長円形スポット光が液晶パネルを透過して、投射光学系９によってスクリーン１０へ投射し、３色のストライプ部分映像の垂直走査によりフルカラー画像を形成する。
【０００７】また、かかるＲＧＢ平行方式の回転プリズムの光学系は、図２Ａ，Ｂに示すように、Ｇを主光軸としてＲＢを２つの副光軸として、ＲＢ副光軸がＧ主光軸に接近し光束が入射する場合（近軸）から、図２Ｃ，Ｄに示すように、徐々に遠くなる場合（遠軸）まで、光路を考慮して設計される。図２の左に、各光路に対応するプリズム回転による液晶パネル上のＲＧＢの長円形スポットＳの照射位置の変化を示す。
【０００８】すなわち、近軸入射におけるプリズムの屈折率が小さい（図２Ａ）又は大きい（図２Ｂ）場合、光束が近接して入射しているのでパネル上の長円形スポット幅（短径）を大きくすることができず、画面を明るくすることが難しくなる。近軸入射でプリズム屈折率が大きい（図２Ｂ）場合、隣合うＲＧＢ組のＢＲ間の間隔が広くなり、また、ＲＢ入射位置がＧ入射位置と異なるために垂直走査後の長円形スポットの上方帰還の位置がＲＢとＧで異なる問題がある。
【０００９】図２Ｃ，Ｄに示す遠軸入射における単一液晶パネル方式では、ＲＢ副光軸の長円形スポットの上方帰還の位置の問題のほかに、ＢＲ副光軸の光束がプリズムに略９０度までの大きな角度で入射するので、分散によりパネル上の走査開始又は終了において色ずれが大きくなる問題や、４５゜以上の入射角度で広い周波数領域をカバーできる反射防止膜はなく、入射光の反射防止措置は不可能で光量損失の問題がある。また、遠軸入射でプリズムの屈折率が小さい場合（図２Ｃ）、副光軸の光束がプリズムの対向する平行面からの出射光路を得ることができず（光路ｆ参照）、長円形スポットが液晶パネル上に形成されない問題がある。
【００１０】遠軸入射でプリズムの屈折率が大きい場合（図２Ｄ）でも、ＲＢ副光軸の長円形スポットが液晶パネル上に形成されない問題はある。すなわち、図３及び図４に示すように、プリズムが回転角０度から回転した場合、ＲＧＢ長円形スポットは、プリズム内のＢ光束が光軸に平行(図３Ａ，図４Ａ)からプリズム下流側の頂点エッジｅに達するまでの角度範囲内は、図３Ｂ及び図４Ｂの如く平行に垂直走査される。Ｂ光束入射点がプリズム上流側のエッジｄに達すると、図３Ｃ及び図４Ｃに示すように、Ｂ光束は、プリズム下面上流側の頂点を越えてプリズム下面から入射し、高屈折率故に、屈折したＢ光束はプリズムエッジｅを一時的に渡り、Ｂ光束の入射面の対向上方平行面から光軸に平行に出射する。しかし、さらに回転すると、図３Ｄ及び図４Ｄに示すように、プリズムエッジｅが、屈折したＢ光束を横切り、Ｂ光束は対向上方平行面から出射せず、ＲＧ光束とは平行にならずに入射面の隣接面にて反射される。さらに回転して屈折したＲ光束が図３Ｅ及び図４Ｅに示すプリズムエッジｅに達し、図３Ｆ及び図４Ｆに示すように、図３ＤのＢ光束と同様にＲ光束もその入射面の隣接面にて反射される。その後はＲＢ光束は液晶パネルに達せずＧ光束のみがパネル上で長円形スポットを形成する。プリズム回転角が４５度(図３Ｇ及び図４Ｇ)に達すると、Ｇ光束はその入射面の対向上方平行面から軸に平行に出射する。このように、遠軸入射で高屈折率プリズムの場合でも、ＲＢ副光軸の光束の長円形スポットが液晶パネル上に形成されない場合がある。なお、図４は、プリズム側面が主光軸に垂直である時を基準（０度）として回転角９０度までの範囲において、プリズムにおける主光軸からＲＧＢ光束の出射点までの高さｈの変化を示す。図４のＲＧＢ曲線において、実線部分はパネル上で長円形スポットがＲＧＢ光束の出射高さに対応して形成され、破線部分Ｒｎ，Ｂｎは長円形スポットがパネル上で形成されずＲＢ光束が反射されていることを示す。また、図４の矢印Ａ～Ｇは図３Ａ～Ｇに示すプリズム回転角度位置を示す。
【００１１】このように、いずれの場合もＲＧＢ平行方式の単一液晶パネル型プロジェクタでは、パネルに平行ＲＧＢ長円形スポットを形成するのに問題が多く、回転プリズムの屈折率及び大きさ並びに副光軸の光束の入射位置に制限が多く、設計の自由度が小さく、設計が難しい。
【００１２】
【発明が解決しようとする課題】かかる単一液晶パネル方式液晶プロジェクタでは、図１に示すように、メタルハライドランプ１がその長手方向を主光軸に沿って置かれ、放物面状の回転対称リフレクタ２が用いられている。メタルハライドランプ１の長手方向を光軸に一致させた従来の光源では、集光性能を高めるために、放電電極間を縮め提灯型ランプ部分を小型化する必要があるが、それには限界があり、提灯型ランプ部分から両側の光軸方向に伸びる電極保護部分が遮光、光散乱の原因になり、集光性能だけでなく光量の損失にもなっている。光学部品を透過する光束の光量損失を低下させ光量を確保することが、液晶プロジェクタにおいて望まれている。
【００１３】また、副光軸の光束の回転プリズムへの入射位置を遠軸又は近軸ではなく中庸に入射位置を設定しても、図５に示すように、液晶パネル上におけるＲＢ副光軸の光束の長円形スポットの垂直走査の始点位置がＧ光軸のそれと異なり、さらに図５のＭ，Ｎに示す曲線部分では、ＢＲの長円形スポットがＧのそれと等しい照射移動速度とならない。この長円形スポットの照射移動速度のバラツキは、ＢＲスポットの明るさの不均一を発生

させ、投射画像の色ムラの原因となる。

【００１４】そこで本発明の目的は、上記問題点を解決すべく、ＲＧＢ長円形スポットの間隔を均一に保ち、それらの照射移動速度の線形性も高く投射画面が明るい色ムラのない液晶プロジェクタを提供することにある。

【００１５】

【課題を解決するための手段】本発明の液晶プロジェクタは、光源と、光源からの光を反射し集光させるリフレクタと、集光された光束を赤、緑及び青の３色の光束に分離する光分離手段と、液晶パネルと、回転軸に線対称で対向平行面を有する正多角形断面の柱状体からなりかつ、その側面に前記３色の光束を受けこれらを前記液晶パネル上にストライプ状に照射して、３色のストライプを前記液晶パネル上で走査する回転プリズムと、を有し、前記３色の光束の１つを主光軸として該主光軸が前記回転軸に直交する液晶プロジェクタであって、前記３色の光束の残る２つを副光軸として、該副光軸を、前記主光軸に対して対称に傾斜せしめかつ前記主光軸及び前記回転軸の交点に入射する入射手段と、前記副光軸を前記主光軸に平行に集合する集合手段とを備えることを特徴とする液晶プロジェクタ。

【００１６】

【作用】本発明によれば、液晶パネル上のＲＧＢのストライプ光束の垂直走査の始点位置が一定でかつ、それらの間隔がほぼ一定で照射移動速度の線形性も高い液晶プロジェクタが得られる。すなわち、本発明によれば、垂直走査が全て等しい速さで可能となり、ストライプ幅及び間隔はＲＧＢ平行方式よりも広く設定でき、投射画面が明るい色ムラのない液晶プロジェクタが得られる。

【００１７】

【実施例】以下に、本発明による実施例を図面を参照しつつ説明する。図６に本実施例によるＲＧＢ交差方式の液晶プロジェクタを示す。図６において図１に示す同一符号で示す部材は同一のものを示す。ＲＧＢ交差方式単一液晶パネル液晶プロジェクタは、白色の光源のメタルハライドランプ１１と、光源からの光を細い光束とするための縦と横で離心率の異なる碗状の楕円リフレクタ１２とを含む光源光学系を備えている。また、本実施例は、光束を走査せしめる回転プリズム６と、白色の光束をＲＧＢの光束に分ける手段であるダイクロイックプリズム３と、これにより分けられたＲＢの副光軸を回転プリズム６へ向けてＧの主光軸に対して対称に傾斜せしめて回転軸Ａに交差せしめるように入射する一対のミラー１４，１５と、ＲＢの副光軸をＧの主光軸に一致させる集合手段とを含む回転プリズム系を備えている。当該集合手段は、主光軸上の第２のダイクロイックプリズム２３と、主光軸及び回転軸Ａに関してミラー１４，１５と共役に配置されかつ、第２のダイクロイックプリズム２３へＲＢの副光軸を案内しこれらをＧの主光軸に一致させる第２の反射ミラー２１，２２とからなる。また、本実施例は、一致したＲＢの副光軸及びＧの主光軸上に配置されたアナモルフィックレンズ７、液晶パネル８及び投射レンズ９からなる照射光学系を備えている。

【００１８】ここで、両ダイクロイックプリズム３，２３は、入射光をその波長に応じて、そのまま平行に通過させる波長成分と、それぞれ反対方向に入射光に垂直に反射する２つの波長成分と、に分割するように（さらに波長成分を重畳させるように）傾斜多層薄膜を有するプリズムを用いているが、これに限らず、３つの波長成分に分割できるのもであればよい。

【００１９】以下に、光源光学系、集合手段を含む回転プリズム系及び照射光学系について詳述する。

（光源光学系）まず、光源光学系は、液晶パネル上を細幅の線状のストライプ状で照射するのに適した構成にする。図７に示すように、Ｚ軸を主光軸に一致させ液晶パネル上にて主光軸に垂直のストライプ伸長方向をＸ軸に一致させ、ストライプの垂直走査方向をＹ軸に一致させた座標系において、楕円リフレクタ１２は、縦Ｙ軸の離心率が横Ｘ軸の離心率より小となる反射内面を有する碗形状の反射ミラーである。細長いメタルハイライドランプ１１は、楕円リフレクタ１２内部の焦点Ｐにて、その長手方向を、形成すべきストライプと平行となるように横置きにする。ストライプ走査方向を含むＹＺ面では、ランプ中央の提燈型発光部１１ａを楕円リフレクタ１２の内部焦点Ｐに置き、細長い提燈型発光部１１ａの発光パターンを基本的にはそのまま液晶パネルに導く光学系とする。このために、Ｙ方向の集光性能が高くなる。ＸＺ面では基本的には長い発光形状のまま液晶パネル方向に光を案内する。よって、楕円リフレクタ１２の外部焦点ＱではＺ方向の細長い集光領域が得られる。これにより、液晶パネル上のストライプ幅はより密度の高いものとなるが、さらに、下流の光学系の有効径を考慮して従来よりも屈折力の小さいアナモルフィック光学系を液晶パネル前に配置して調整できる。

【００２０】さらに、本実施例では、後述のコリメータ系により、液晶パネルにおけるストライプの最大照射線幅を液晶パネル上のストライプの画像表示部分と同等程度まで細くして、スクリーンの単位面積当りの光量を増加せしめる。３パネル方式などの液晶パネルを面で照射する方式と異なり、本実施例では、線ストライプで照射するため、光と熱の単位面積当りのエネルギーが高くなる。

【００２１】光源光学系は、図６及び７に示すようにコリメータレンズ１７を備えており、液晶パネル及び光学部品の熱保護のために、コリメータレンズ１７及び楕円リフレクタ１２間に凹内部反射面の円形ミラー１６を有する。円形ミラー１６は外部焦点Ｑにおける光束の通る部分にだけＸ方向に伸びるスリット１６ａを有し、その曲率半径の中心は楕円リフレクタの内部焦点Ｐと一致するように配置される。これによりランプ１１から直接円

形ミラー１６へ達する光を焦点Ｐへ反射させ有効な光として再度利用する。コリメータレンズ１７はスリット１６ａから出射した発散光をＸＺ面上の板状の平行光線束に変換する。

【００２２】光源光学系は、図６及び図８に示すように、さらにコリメータレンズ１７から出射した平行光線束のＰ偏光のみを透過する偏光ビームスプリッタ（ＰＢＳ）１８をも備えている。Ｐ偏光を用いるのは、下流の液晶パネルではＰ又はＳ偏光の何れか１つの偏光の透過量を変調するからである。また、ＰＢＳ１８内部においてＳ偏光が反射した先のＰＢＳ面には、光量有効利用のため光源に光を戻すコールドミラー１９を設ける。このＰ偏光の平行光線束がダイクロイックプリズム３へ案内される。

【００２３】上記実施例では、熱対策と同時に光量増加のために円形ミラー１６とＰＢＳ１８とを有しているが、図９に示すような、Ｓ偏光を有効に用いる構成としてもよい。ＰＢＳ１８のコールドミラーを除き、代わりにＰＢＳ内部において反射したＳ偏光を先のＰＢＳ面から取り出し、ミラー３０でＳ偏光の光路を変えλ／２波長板３１でＳ偏光をＰ偏光にした後、このＰ偏光とＰＢＳ１８によるＰ偏光とを、Ｖ字断面柱状レンズ３２，コリメータレンズ系３３，３４により合成する。Ｖ字断面柱状レンズ３２内部で両者Ｐ偏光は平行となりレンズ３３で集束されレンズ３４で平行光線束となる。また、ここでλ／２波長板３１としたが、実際にはλ／２波長板の代わりに反射ミラー３０の表面に数層の位相調整薄膜を設け、反射する光の位相を９０゜変化せしめてもよく、これにより組立て部品が減ることになる。

（回転プリズム系）回転プリズム系は、図１０に示すように、Ｇの主光軸５１及びＲＢの副光軸５２，５３を有している。ダイクロイックプリズム３，２３と、反射ミラー１４，１５、２１，２２とは、主光軸５１及び副光軸５２，５３を規定している。ミラー１４，１５は、ダイクロイックプリズム３により分けられた主光軸５１に垂直なＲＢの副光軸を、それぞれ回転プリズム６へ向けてＧの主光軸５１に対して対称に角度θで傾斜せしめて回転軸Ａに交差させている。したがって、各主光軸及び副光軸に沿って入射する光束の偏向は回転プリズムの回転角に関して等価となる。

【００２４】図６に示す液晶プロジェクタにおいては、ＲＢの副光軸はそれぞれ３０度の角度θでＧの主光軸に対して対称に傾斜している。図１１(Ａ)～(Ｅ)に、図６の回転プリズム系におけるプリズム回転角０度から４５度までの回転角度範囲内のいくつかの光路状態を示す。何れもＲＧＢ光束が平行に垂直走査されることが分かる。

【００２５】図１２に、図６の回転プリズム系におけるＲＧＢ光束が平行に入射及び出射するプリズム回転角を０度として回転角９０度までの範囲において、プリズムから出射するＲＧＢ光束の主光軸からの位置（高さ）の変化のグラフを示す。図１２のＲＧＢ曲線において、ＲＧＢ光束の出射高さに対応してストライプがパネル上で形成され、かつ略等しい間隔で平行に垂直走査されることが分かる。また、図１２の(Ａ)～(Ｅ)は図１１に示す(Ａ)～(Ｅ)のプリズム回転位置を示す。

【００２６】また、図９に示すように、回転プリズムに反射防止膜６ａが付けられる。実施例のＲＧＢ交差方式では、対向平行面を有する回転軸に線対称な正方形断面の柱状体である回転プリズムを用いているので、光線入射角度が最大４５゜で、回転プリズムの表面に反射防止膜６ａを付けることが可能である。それに対し従来のＲＧＢ平行方式では副光軸の光束が４５゜以上の入射角度で入射するが、４５゜以上の入射角度で広い周波数領域をカバーできる反射防止膜はなく、反射防止措置は不可能であったが、本発明により反射防止措置が可能となる。

【００２７】図１３に、照射移動速度の非線形度合いについて示す。ＲＧＢ光束のＧを例に挙げて調べると、プリズム回転角度に対するストライプ垂直走査（０～９０度の範囲）の変移距離及び変移時間がプリズム回転角度３０゜と６０゜付近でそれぞれ線形移動に対して１．３㎜及び１０μｓ程度が最大である。よって、これらは実用上特に大きな補正すべき変移距離及び変移時間ではない。もし影響が出る場合には、図１０に示すように、第２のダイクロイックプリズム２３の出射表面に透明樹脂材料又はガラスで形成した補正板５０を直接貼り付け又は、出射側に挿入して設ければ、光束の動きは完全な線形になる。補正板５０の垂直方向断面のプロフィルは図１３に示す非線形の度合いを元に形成される。

【００２８】図１４(Ａ)～(Ｄ)に、図１０に示す主光軸５１に対する副光軸５２，５３の傾斜角度θを、０≦θ≦４５度の角度範囲で変化させた場合の回転プリズム系の各部材の配置を示す。傾斜角度θ≒０度，θ≒４５度では各部材が近接又は遠方となるのでミラーが配置できない、よって、かかる範囲で適宜各部材を配置する。図１５(Ａ)～(Ｄ)は、図１４(Ａ)～(Ｄ)に示す回転プリズム系の各部材の配置に対応する、回転プリズムの回転角に対するＲＧＢ光束の出射高さの変化のグラフを示す。

【００２９】図１５(Ａ)及び(Ｄ)に示すように、図１４(Ａ)及び(Ｄ)に対応する副光軸の傾斜角度θ＝４５度及びθ＝０度ではではＲＢ光束及びＲＧＢ光束が分離せずに１つのストライプとなってしまう。これらから明らかなように副光軸の傾斜角度θ≒４５度及び傾斜角度θ≒０度ではＲＧＢ光束がそれぞれ近接し重畳して好ましくないことが分かる。

【００３０】図１５(Ｂ)に示すように、図１４(Ｂ)に対応する副光軸の傾斜角度３０度＜θ＜４５度ではＲＢ光束が分離するものの、ＲＢ光束の間隔とＧ光束及びＲ又はＢの間隔とが等しくなる場合と等しくならない場合と

が交互に現れ画面のチラツキの原因になる。図１５(Ｂ)から明らかなように傾斜角度３０＜θ＜４５度ではＲＧＢ光束が間隔が不均一になり好ましくないことが分かる。

【００３１】一方、図１２から明らかなように傾斜角度θ＝３０度ではＲＧＢ光束の組内でも等間隔でかつＲＧＢ帰還後のＲＢ間隔をも等間隔で走査が行われる。さらに図１５(Ｃ)から明らかなように０＜θ＜３０度ではＲＧＢ帰還後のＲＢ間隔が広くなるものの、ＲＧＢ光束の組内では等間隔の走査が行われることが分かる。よって、主光軸５１に対する副光軸５２，５３の傾斜角度は、各部材の接触、大きさ等を考慮して０＜θ≦３０度の角度範囲で選ばれ得る。

【００３２】他の実施例としては、図１６に示すように、図１０に示す高価な一対のダイクロイックプリズム３並びに２３に代えて、それぞれ安価なダイクロイックミラー３ａ，３ｂ並びに２３ａ，２３ｂを主光軸５１上に配置し、対応する反射ミラー１４，１５、２１，２２を副光軸５２，５３に沿って変移させて入射及び出射の光束の軸を一致させるように構成できる。第２のダイクロイックプリズム２３と反射ミラー２１，２２とは主光軸５１において回転プリズム６の回転軸Ａに関してダイクロイックプリズム３と反射ミラー１４，１５とに共役に配置されており各軸が等価であるので、各軸の光路長は問わないからである。また、一対のダイクロイックプリズムの一方のみをダイクロイックミラーに置換してもよい。

【００３３】上記実施例の図１０に示すＲＧＢ交差方式では正方形断面の柱状体である回転プリズムを用いているが、これに代えて、対向平行面を有する回転軸に線対称な正六角形、正八角形等の正多角形断面の柱状体である回転プリズムを用いて構成できる。上記実施例では、ＲＧＢ光束のＧを副光軸、ＲＢを副光軸として、副光軸を主光軸に対して対称に傾斜せしめかつプリズム回転軸に交差せしめ、副光軸を主光軸に平行に一致するように配置するので、正方形断面プリズムの場合、光束の最大入射角度が４５度であり、０＜θ≦９０度の角度範囲で１周期のＲＧＢ光束の垂直走査が得られ、副光軸の対称傾斜角度θが９０度／３＝３０度で等間隔（周期）でＲＧＢ光束の垂直走査が得られる。よって、他の正多角形断面プリズムを用いる実施例としては、図１７に示すように、例えば、正六角形断面の柱状体回転プリズム６０を用いた場合、光束の最大入射角度が３０度であり、０＜θ≦６０度の角度範囲で１周期のＲＧＢ光束の垂直走査が得られ、副光軸の対称傾斜角度θが６０度／３＝２０度で等間隔の垂直走査が得られる。図１７において図６に示す同一符号で示す部材は同一のものを示す。また、正八角形断面の柱状体回転プリズムを用いた場合、光束の最大入射角度が２２．５度であり、０＜θ≦４５度の角度範囲で１周期のＲＧＢ光束の垂直走査が得られ、副光軸の対称傾斜角度θが４５度／３＝１５度で等間隔の垂直走査が得られる。

【００３４】正四角形を越える正六角形、正八角形の正多角形断面プリズムを用いる場合、液晶パネル上のストライプ光束の移動速度の非線形度合が正四角形断面プリズムの場合よりも高くなる。対応する正多角形の外接円及び内接円の半径差の距離がより減少し、入射光束のプリズム面における半径方向の変移が減少するからである。よって、第２のダイクロイックプリズムの出射表面に補正板を設けることもなくなる。

（照射光学系）図６に示す液晶プロジェクタの液晶パネル８へはシート状のＲＧＢ光束が入射されるが、さらにストライプ幅を鮮明に液晶パネル８へ映す場合、アナモルフィックレンズ７が一致したＲＧＢの主光軸上に配置される。このアナモルフィックレンズは、像面上で縦方向と横方向の倍率が異なる像を生ずる光学系なので光源部分の設計と同時に行う。アナモルフィックレンズが液晶パネルの直前で投射光学系の倍率を変える倍率調節手段の１つである。

【００３５】液晶パネル８は、画素数を多くするため、さらに光の透過率を上げて明るくするために、大きくする必要があるので、比較的小さい回転プリズム系等の光学部品を小型に維持しておくために、さらなる倍率調節手段として拡大レンズ７ａを投射レンズ９及び回転プリズム６間に設けることもできる。これにより、液晶パネルの大型化と回転プリズム系等の小型化との整合性をとることができる。

【００３６】液晶パネル８は、応答時間２．５ミリ秒のＴＦＴ(Thin Film Transistor)方式の液晶パネルが用いられ、例えば、６０ｍｍ（水平方向）×３４ｍｍ（垂直方向）の大きさであれば、ストライプ照射面積が６０ｍｍ（水平方向）×１５ｍｍ（垂直方向）以内の大きさとして、部分映像表示部分及び遮光部分のデューティー比が１：１の場合６０ｍｍ（水平方向）×５．７ｍｍ（垂直方向）の大きさが部分映像表示部分及び遮光部分の大きさとなる。ストライプは液晶パネルの映像表示部分の上下両側の遮光部分を越えない範囲に照射されクロストークが生じないようにするためである。本実施例によれば、光源から板状（シート状）のＲＧＢ光束を発生せしめ、回転プリズムの回転軸へのＲＧＢ光束の入射を行っているので、部分映像表示部分及び遮光部分のデューティー比の設定が従来のＲＧＢ平行方式の場合よりも広く設定できる。

【００３７】また、液晶パネル８には、図６に示すように、その主面の主光軸に対する角度を可変にする角度調節手段７０が設けられている。液晶パネル８は、例えばその主光軸上の回転軸にジャーナルによって枢支され、角度調節手段７０が液晶パネル８の例えば下端縁部を主光軸に沿って駆動する。図１８に示すように、液晶パネル８の主面を主光軸に対して角度を変化させると、単一

液晶パネル方式であるために、スクリーン１０の法線が主光軸に対して傾斜していても、台形歪みのない映像を得ることができる。
（液晶パネル及びプリズム駆動系）液晶プロジェクタは、図６に示すように、例えば、ＲＧＢ変換回路１００、フレームバッファメモリ１０１Ｒ，１０１Ｇ，１０１Ｂ、ストライプ信号選択回路１０２Ｒ，１０２Ｇ，１０２Ｂ、コントローラ１０３、時間圧縮回路１０４Ｒ，１０４Ｇ，１０４Ｂ、時分割回路１０５、液晶パネル駆動回路１０６、及びプリズム駆動手段１０７を有する。
【００３８】Ａ／Ｄ変換器を含むＲＧＢ変換回路１００が、例えば、ＮＴＳＣ信号映像信号をＲ，Ｇ及びＢのデジタル信号に分けて、信号それぞれがフレームバッファメモリ１０１Ｒ，１０１Ｇ，１０１Ｂに書き込まれる。ストライプ信号選択回路１０２Ｒ，１０２Ｇ，１０２Ｂがこれら書き込まれたフレームデータからＲ映像の上部分ラスタ、Ｇ映像の中央部分ラスタ及びＢ映像の下部分ラスタの輝度データをコントローラ１０３からの選択指令に応じてそれぞれ選択抽出する。時間圧縮回路１０４Ｒ，１０４Ｇ，１０４Ｂがこれら抽出データをコントローラ１０３からの圧縮指令に応じてそれぞれ圧縮する。選択器、遅延回路、マルチプレクサ及びＤ／Ａ変換器を含む時分割回路１０５は、コントローラ１０３からの選択指令に基づいて、縮された部分ラスタデータのすべてを１つにして、液晶パネルの駆動回路１０６へ転送する。駆動回路１０６は、各ＲＧＢの輝度の部分ラスタデータにより形成されたストライプ映像を、液晶パネルに上から下へ垂直走査して表示する。
【００３９】スピンドルモータ及び回転検出器を含みプリズムを回転駆動するプリズム駆動手段１０７は、コントローラ１０３に接続されている。コントローラ１０３は、回転検出器からの回転データに基づいて、プリズム駆動手段１０７を制御しプリズムを回転せしめるとともに、ＲＧＢのストライプ映像の垂直走査に同期させて、各ＲＧＢの輝度のストライプ光束を上から下へ垂直走査する。すると、液晶パネルのＲＧＢの各輝度情報表示部分にＲＧＢのストライプをそれぞれ照射して上から下へと画面を作ることができる。このように、３原色映像の一部分に対応する３色のストライプ部分映像（部分ラスタ）を単一液晶パネル上に順次形成し、ストライプ部分映像に対応するストライプ状の光束を液晶パネルに同期して透過させて、フルカラー映像を作る。
【００４０】視感上の彩度の高い色の部分での色のチラつき（カラーフリッカ）が目立つことを解決するために、分解された３原色映像信号を１／３に時間圧縮し、フレーム周波数を３倍の１８０Ｈｚとしてストライプを順次に切り替える。さらに、映像の輪郭部分に色がつく、「色割れ」と呼ばれる現象も抑制できる。この表示方式では、フレームごとの映像のズレが大きい場合、３原色の合成に要する時間よりも映像の移動が速いと輪郭部が実際の色とは違った色に見えてしまうことがあるが、時間圧縮回路を使ってフレーム周波数を１８０Ｈｚにすることで、実用上ほとんど問題にならないレベルとなる。
【００４１】
【発明の効果】以上の如く、本発明によれば、光源と、光源からの光を反射し集光させるリフレクタと、集光された光束を赤、緑及び青の３色の光束に分離する手段と、液晶パネルと、回転軸に線対称で対向平行面を有する正多角形断面の柱状体からなりかつ、その側面に３色の光束を受けこれらを液晶パネル上にストライプ状に照射して、３色のストライプを液晶パネル上で走査する回転プリズムと、を有し、３色の光束の１つを主光軸として該主光軸が回転軸に直交する液晶プロジェクタにおいて、３色の光束の残る２つを副光軸として、該副光軸を、主光軸に対して対称に傾斜せしめかつ主光軸及び回転軸の交点に入射する手段と、副光軸を主光軸に平行に集合する手段とを備えるので、液晶パネルでのＲＧＢのストライプが緩和された条件で確実に形成され、ストライプ光束の垂直走査の始点位置が一定でかつ間隔がほぼ一定で照射移動速度の線形性も高い液晶プロジェクタが得られ、明るい投射画像を得ることができる。
【図面の簡単な説明】
【図１】ＲＧＢ平行方式の液晶プロジェクタの概略を示す構造図である。
【図２】ＲＧＢ平行方式の液晶プロジェクタの回転プリズムと垂直走査されるストライプとの様子を示す説明図である。
【図３】ＲＧＢ平行方式の液晶プロジェクタの回転プリズムの概略断面図である。
【図４】ＲＧＢ平行方式の液晶プロジェクタの回転プリズムの回転角度と主光軸からの出射光束の高さとの関係を示すグラフである。
【図５】ＲＧＢ平行方式の液晶プロジェクタの回転プリズムの回転角度と主光軸からの出射光束の高さとの関係を示すグラフである。
【図６】実施例のＲＧＢ交差方式の液晶プロジェクタの概略を示す構造図である。
【図７】実施例の液晶プロジェクタにおける光源部分のメタルハライドランプ及びリフレクタを示す斜視図である。
【図８】実施例の液晶プロジェクタにおける光源部分の概略断面図である。
【図９】他の実施例の液晶プロジェクタにおける光源部分の概略断面図である。
【図１０】実施例のＲＧＢ交差方式の液晶プロジェクタにおける回転プリズム部分の概略断面図である。
【図１１】実施例のＲＧＢ交差方式液晶プロジェクタにおける回転プリズムの概略断面図である。
【図１２】実施例のＲＧＢ交差方式液晶プロジェクタに

おける回転プリズムの回転角度と主光軸からの出射光束の高さとの関係を示すグラフである。

【図13】実施例のＲＧＢ交差方式液晶プロジェクタにおける液晶パネル上のストライプの照射移動速度の非線形度合いについて示し、プリズム回転角度に対するストライプ垂直走査の変移距離及び変移時間を示すグラフである。

【図14】他の実施例の液晶プロジェクタにおける回転プリズム部分の概略断面図である。

【図15】図13に示す他の実施例に対応する回転プリズムの回転角度と主光軸からの出射光束の高さとの関係を示すグラフである。光源部分の概略断面図である。

【図16】他の実施例のＲＧＢ交差方式の液晶プロジェクタにおける回転プリズム部分の概略断面図である。

【図17】他の実施例のＲＧＢ交差方式の液晶プロジェクタにおける回転プリズム部分の概略断面図である。

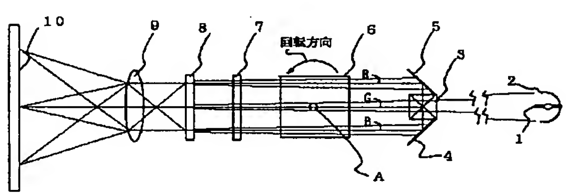
【図18】実施例のＲＧＢ交差方式の液晶プロジェクタにおける照射光学系部分の概略断面図である。

【主要部分の符号の説明】

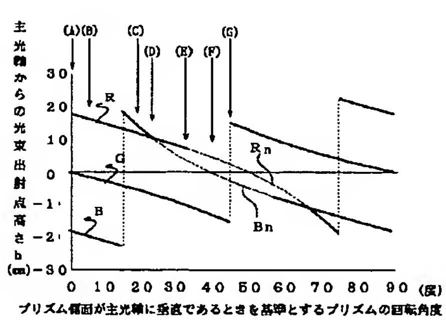
３，２３　ダイクロイックプリズム
３ａ，３ｂ，２３ａ，２３ｂ　ダイクロイックミラー
６　正方形断面プリズム
６ａ　反射防止膜
７　アナモルフィックレンズ
８　液晶パネル
９　投射レンズ
１０　スクリーン
１１　メタルハライドランプ　　＊

＊１２　楕円リフレクタ
１４，１５　ミラー
１６　円形ミラー
１６ａ　スリット
１７　コリメータレンズ
１８　偏光ビームスプリッタ（ＰＢＳ）
１９　コールドミラー
２１，２２，３０　反射ミラー
３１　λ／２波長板
３２　Ｖ字断面柱状レンズ
３３，３４　コリメータレンズ系
３５　位相調整薄膜３５
５０　補正板
５１　主光軸
５２，５３　副光軸
６０　正六角形断面プリズム
７０　角度調節手段
１００　ＲＧＢ変換回路
１０１Ｒ，１０１Ｇ，１０１Ｂ　フレームバッファメモリ
１０２Ｒ，１０２Ｇ，１０２Ｂ　ストライプ信号選択回路
１０３　コントローラ
１０４Ｒ，１０４Ｇ，１０４Ｂ　時間圧縮回路
１０５　時分割回路
１０６　液晶パネル駆動回路
１０７　プリズム駆動手段

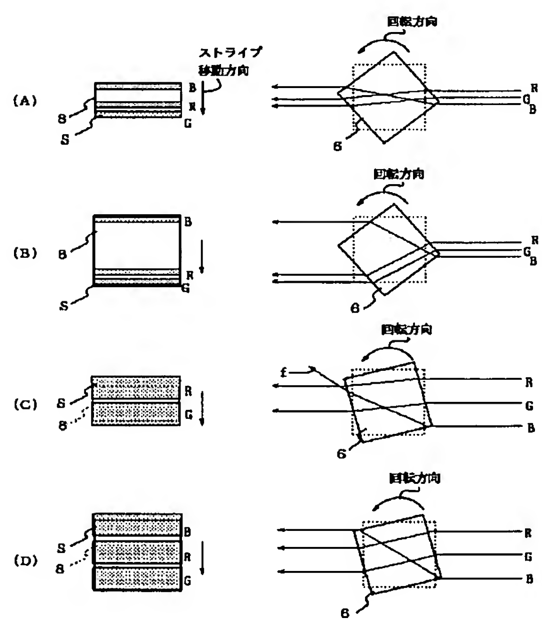
【図１】



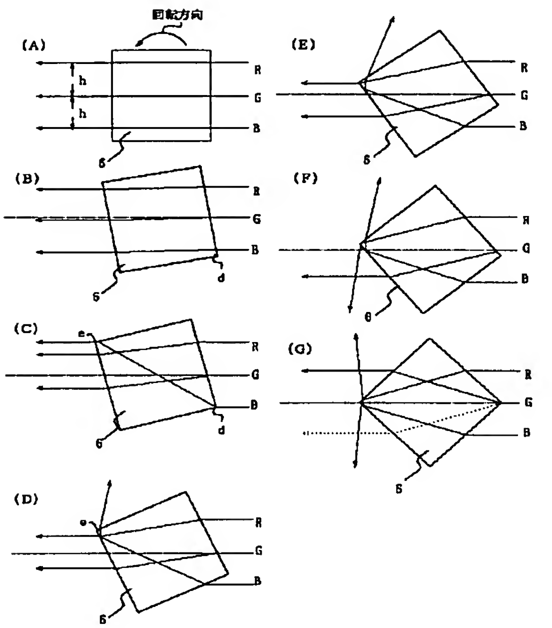
【図４】



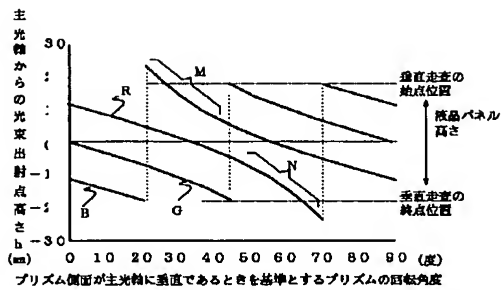
【図２】



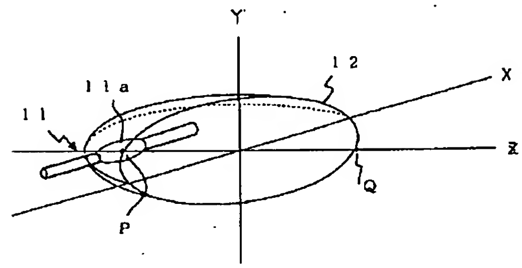
【図3】



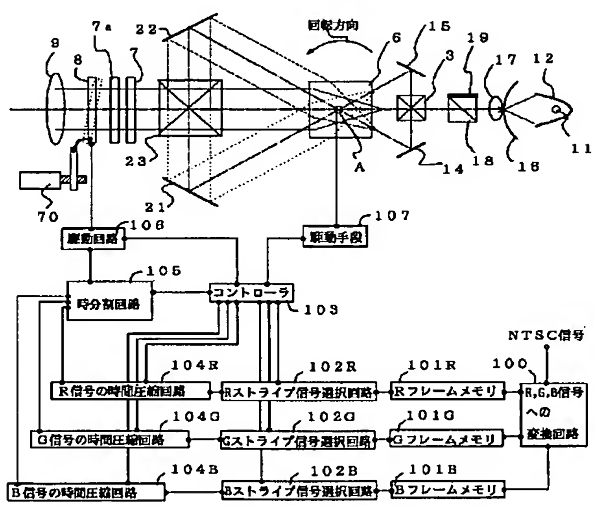
【図5】



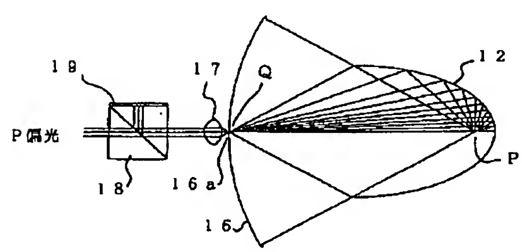
【図7】



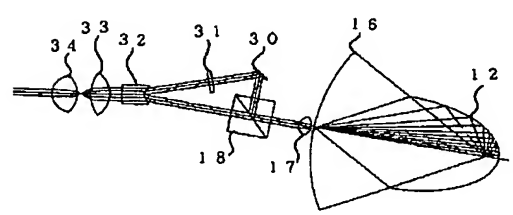
【図6】



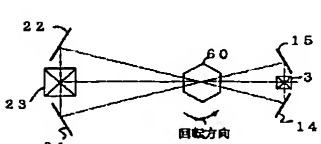
【図8】



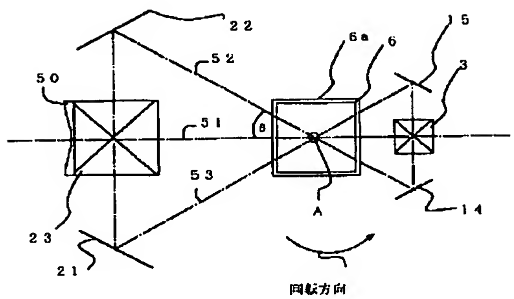
【図9】



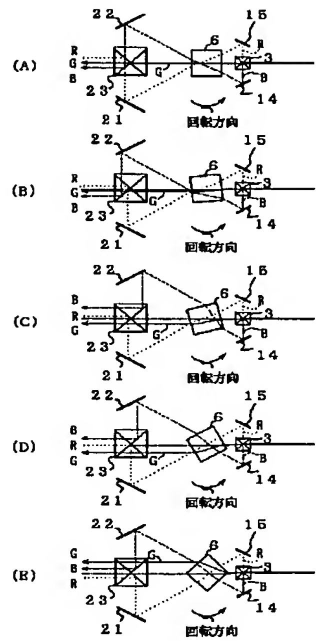
【図17】



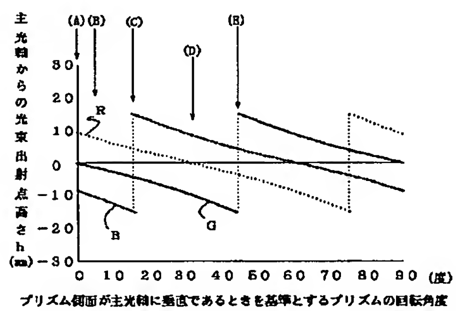
【図10】



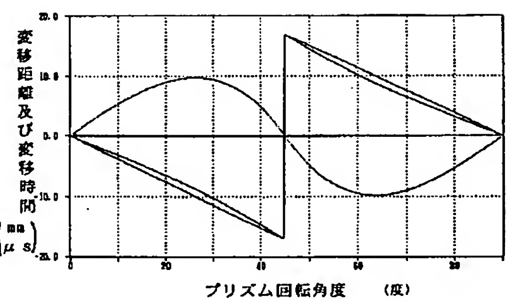
【図11】



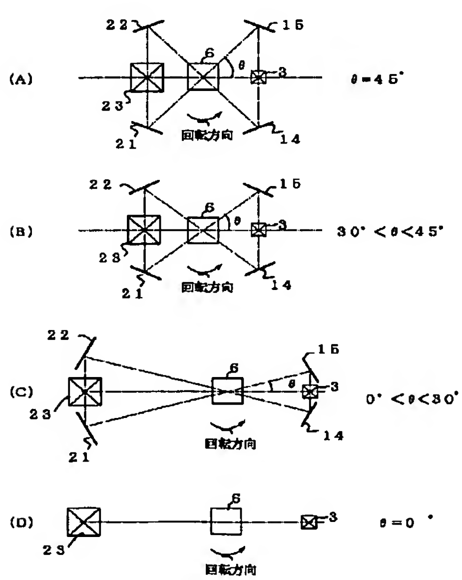
【図12】



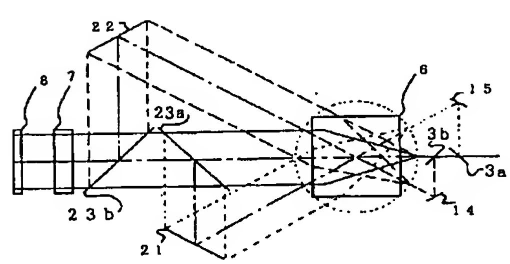
【図13】



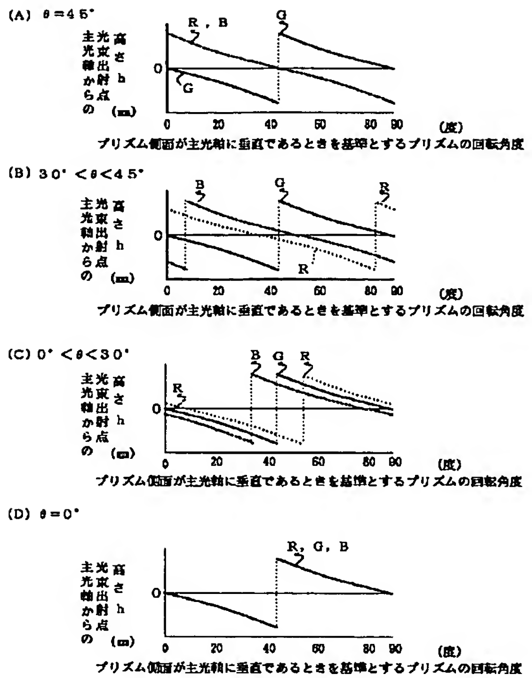
【図14】



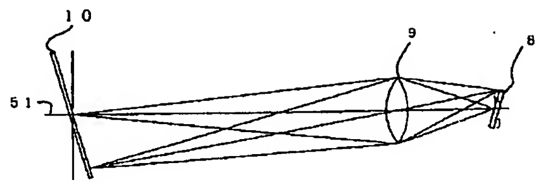
【図16】



【図15】


(A) θ=45°
R, B
G
主光軸からの光束出射点の高さh (mm)
0
20
40
60
80
90
(度)
プリズム側面が主光軸に垂直であるときを基準とするプリズムの回転角度
(B) 30°＜θ＜45°
B
G
R
(C) 0°＜θ＜30°
B
G
R
(D) θ=0°
R, G, B

【図18】


10
9
8
51